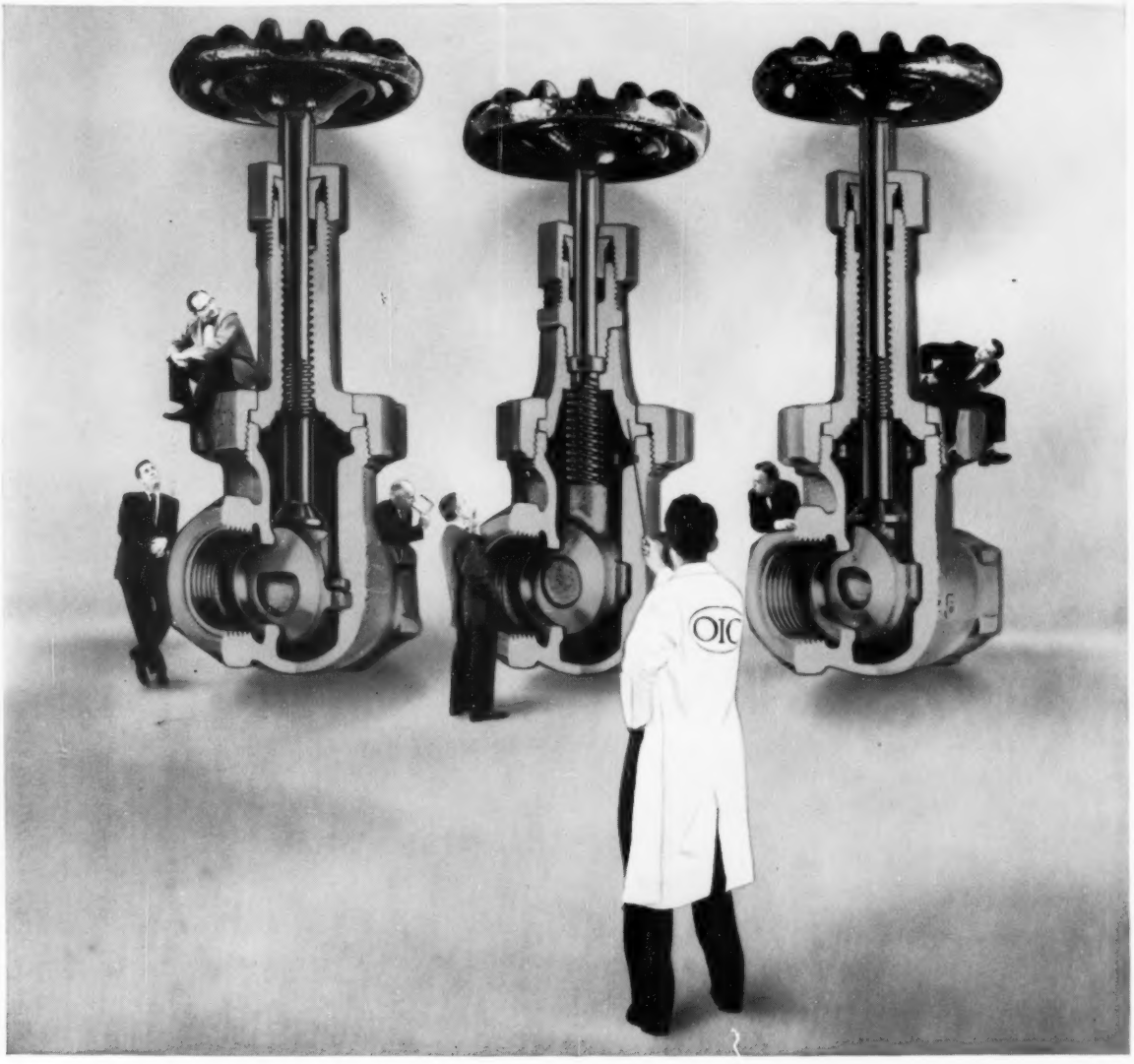
Consulting Engineer

JUNE, 1958

GUY B. PANERO, New York consulting engineer, once listened in wonder as his father told of engineering adventures in Asia Minor – "pretty wild country in those days." Years later Panero, as president of a firm handling projects valued at an estimated $150 million annually, had his own engineering

Continued on page 8

...3 gate valve types in 3 pressure classes, gentlemen, all with safe, efficient (and effective) union ring joints



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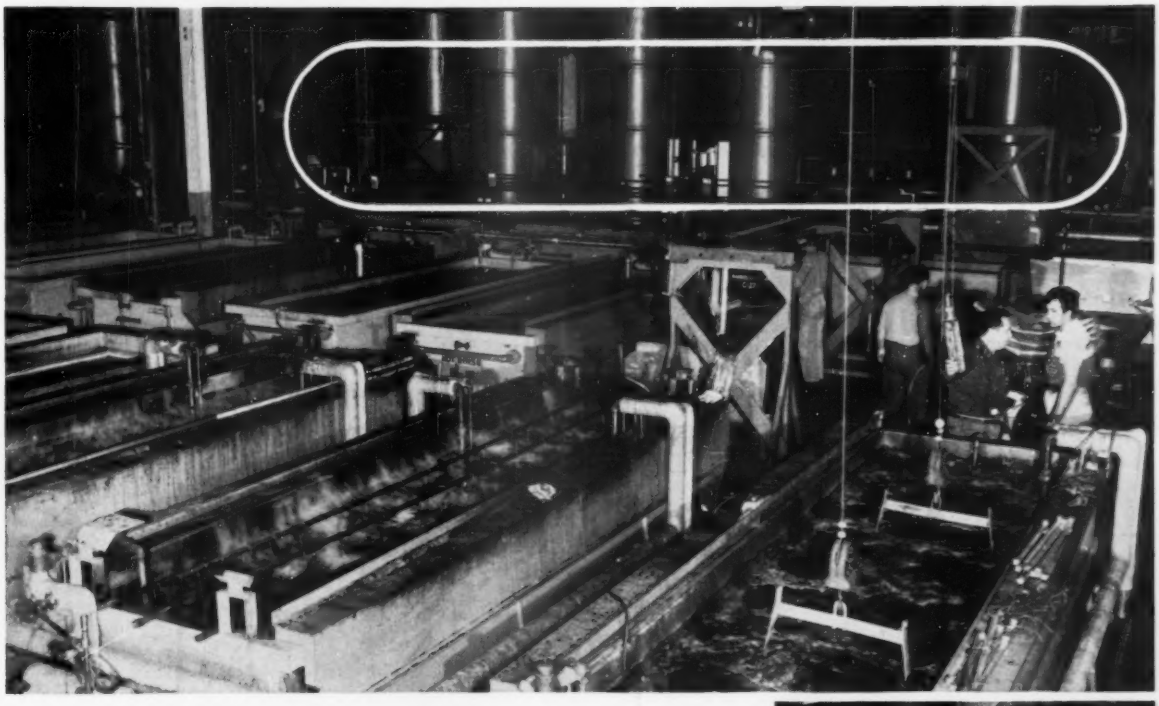

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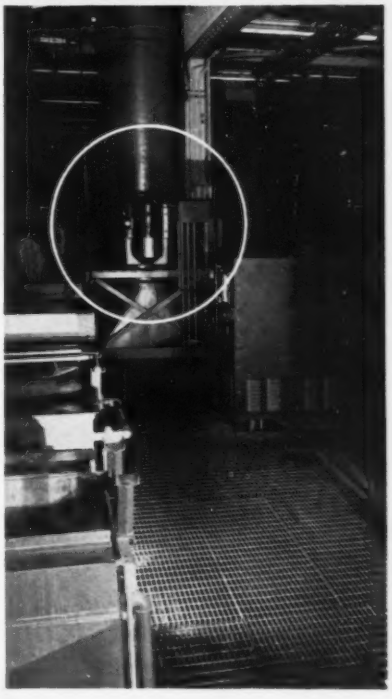

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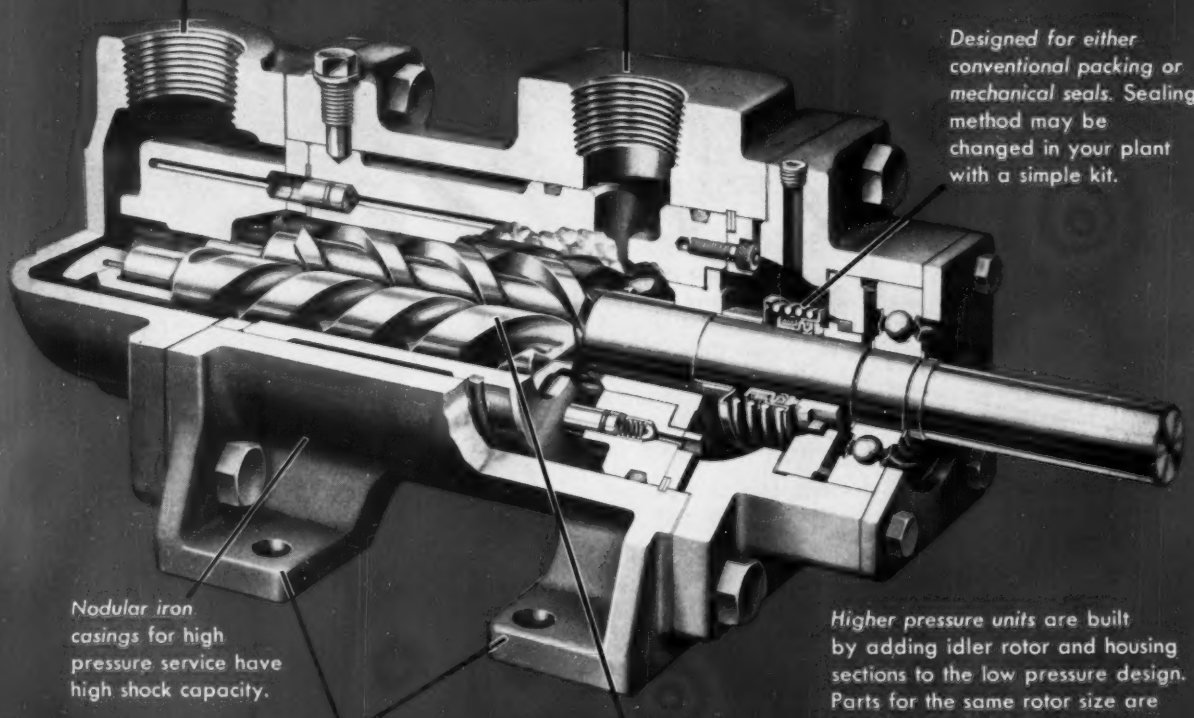

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June 1958 • VOLUME X • NUMBER VI

ARTICLES

78 Steel Piling in Sea Water
Benton C. Lattin

84 A Structural Simulator . . . For Static Analyses
Frederick L. Ryder

92 Theater Stage Engineering — New Field For Consultants
Royce Emerson and Louis Kennel

100 Standard Worksheets . . . For Tailored Specifications
Arthur L. Spaet

108 Soils Engineering . . . For the Interstate Highway Program
David M. Greer

114 This is the Way Consulting Engineers Serve Public Clients
Staff

127 Report From India
T. Drieberg and S. S. Pani

DEPARTMENTS

Cover Personality — Guy B. Panero
16 Readers' Comment
20 Readers' Guide
24 Scraps and Shavings
28 The Word from Washington
32 Legal Aspect
40 Heard Around Headquarters
56 Atoms in Action
66 Report From the West Coast
119 Krick Weather Forecast
142 Report From the East Coast
152 Beyond Our Borders
167 News for the Consultant
174 Men in Engineering
182 New Projects Reported
194 Books
198 Meetings
200 Advertisers' Index

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BPA

Auditorium dome erected in 9 days by a 5-man crew

John J. Kane Hospital, Allegheny County, Pittsburgh, Pa. Auditorium is 109 feet in diameter, seats 682 people.

This auditorium dome for the John J. Kane Hospital went up in a hurry. Four workmen and one superintendent, using one crane with a 125-foot boom, erected the steel work in 9 days.

In preparation for the dome erection, a 20-inch pipe pole with a 48-inch diameter plate top was erected and plumbed. The spider or top section of the dome, which is about 11 feet in diameter, was then placed on top of the pole and bolted down.

The USS Structural Steel ribs were prefabricated on a 53'-7½" radius. They were made in two sections and were field-welded to form one rib almost 80 feet long, depending on the base elevation. The first rib was erected on the west side, followed by one on the east side. Erection then continued clockwise from both points.

The horizontal structural members were bolted in as erection progressed. Most of the bracing was omitted during erection and was filled in by the detail gang later on.

All sections were prefabricated in the plant of the Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.

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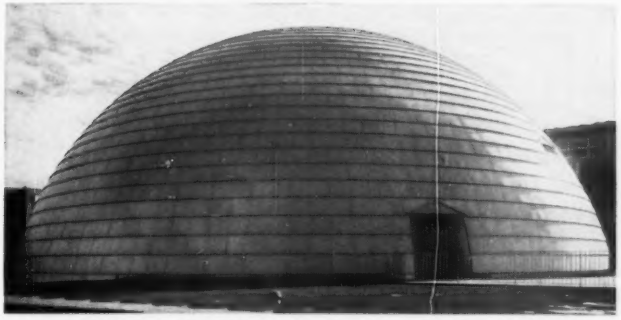

Auditorium dome fabricated from USS Structural Steel, erected by Adams Steel Erection, Kittanning, Pa. • Contractors: Sherry-Richards, Chicago, Ill. • Architects: Button and McLean—Mitchell and Ritchey, Pittsburgh, Pa. • Resident Engineer: Harry King, Allegheny County • Structural Engineers: L. W. Cook—R. A. Zern, Pittsburgh, Pa.

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Guy B. Panero

– *Starts on front cover*

adventures in lands his father once talked about. Panero's firm worked on a joint venture to reclaim one-third of Iran – designing irrigation, erosion prevention, flood control, power, sewage disposal, and water supply facilities.

Although Panero's firm is a versatile one, his personal specialty – underground installations – began shortly after World War II.

Panero was appointed by the Chemical Warfare Service to study chemical processes developed during the war by Germany. He was the only engineer in a special task force of 60 chemical industry experts. The group received a War Department citation for its valuable findings.

During his free time, Panero began a casual study of underground installations in Germany. Soon his studies expanded to include underground defense and industrial installations in other nations, which he found more extensive than he had expected.

Returning to the United States, Panero formed Guy B. Panero & Co., with 16 employees, divided between engineers and draftsmen. Later, Panero purchased the firm of the late Clyde R. Place, and Guy B. Panero Engineers was formed. Today the original 16 have grown to more than 100 employees.

The first major project of Panero's consulting organization was to make an extensive study of underground installations in Germany, France, England, Sweden, and Japan, and make feasibility studies of underground military, industrial, and commercial installations in the United States for the Corps of Engineers.

"Underground Industry is Practical"

"In this and subsequent studies for both our military and industrial clients, we found that underground facilities are entirely practical, feasible, and available," Panero said.

Currently working with the Federal Civil Defense Administration to study general shelter possibilities, Panero feels that it would take four or five years to build minimum shelters in American municipal and industrial areas.

However, Panero believes underground facilities for commercial and industrial use could be established much more easily. He estimates, in his civil defense report, that the U.S. has a potential 300-million square feet of readily available space, not currently being utilized, in drift and shaft mines. In the event of an emergency, an additional 200-million square feet of less-usable space is available in existing mines.

In his report, Panero points out that approximately 60 percent of American industry lies in a quadrangle extending from Boston to Kansas City, and about two-thirds of the existing mine sites suitable for installing underground plants also lie within this central manufacturing area.

Although Panero does not recommend a "Fortress America," he stresses that utilization of underground facilities should be planned now. He points to two examples – Sweden, the exponent of a carefully planned long-range development of permanent underground military and industrial installations, and wartime Germany, which began underground construction with a similar plan.

Sweden already has underground industries, power plants, and military installations, and the program is continuing.

In Germany, the planning gave way to a first-come, first-served basis of allotments of underground space when Allied bombings became extensive during World War II. Panero found 14 individual sites partially completed in the Hartz Mountains at the end of the War.

"If our government agencies ever had to compete with each other for the better spaces, prices would soar and inevitably some of our multipurpose space would end up being used for dead storage purposes, while operations bases, whose underground requirements are very special, would go begging," he said.

Limestone, granite, and sandstone, which are best for underground use, are plentiful in the U.S. However, an industry could be installed underground in virtually any self-supporting formation.

Within space limitations, any facility can be located underground. Among the most adaptable are communication and control centers, light and precision manufacturing, storage of all kinds, and personnel housing or shelter. Already, underground areas are used for commercial storage in Kansas and Missouri, for business records in Pennsylvania, and for some light industry in Kansas.

Difficult, but possible, underground applications could include heavy manufacturing, bulk chemical processes, and oil refining.

Panero finds underground construction of a chemical plant costs one-third more if established in an existing mine, and as much as 60 percent more if developed in a newly excavated site. Operation and maintenance costs also increase somewhat – 4 to 6 percent – mainly because of the need for removing fumes and heat.

A light manufacturing plant might cost 20 percent more if installed in an existing mine or underground area, and nearly half again the cost of an above-ground plant if built into an especially excavated site. Increased maintenance is estimated at 2 to 3 percent.

Storage space is actually less costly in a suitable existing underground area than above ground, and

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can be built into a new site at about 12 percent less than a conventional above-ground structure.

Average over-all unit costs for a square foot of underground floor area are about $13.40 for light manufacturing, $15 for chemical processing, and $6.35 for active storage, based on 1949 costs.

Excavating a geological formation for a specific installation has several distinct advantages. The problem of location is not as difficult, for a wider range of potential sites is available. Also, the excavation can be custom-made to provide the exact requirements of the operation.

Panero estimated excavation costs at $15 per cubic yard in place — "a conservative figure because in a new site there always is the possibility of structural difficulties increasing costs materially.

"To summarize our findings," Panero continued, "limits on the type and extent of underground industrial or military installations are economic and not imposed by the structural characteristics of underground locations."

With his many years of work with the Defense Department and the Federal Civil Defense Administration, Panero is very conscious of America's position in the Cold War. "Unless we have a civil defense, we have no air defense."

Panero, who personally supervised the engineering of approximately $100 million in defense projects before his own firm was formed, cautions Americans about a feeling that this country is invulnerable. "We could become like the French, with their Maginot Line," he added.

In addition to work with underground facilities, Panero has made a major contribution to the safety of America above ground.

Consultants on DEW Line Project

The Guy B. Panero company was awarded the contract from Western Electric for the designs, plans, and specifications for all heating, lighting, plumbing, and associated items on the Distant Early Warning Line stretching from the Aleutians to Baffin Island. This project has been termed, in a booklet written for future DEW Line personnel, "one of the most stupendous engineering tasks ever accomplished by man." Comprised of some three-score (the exact number is a military secret) electronic watchtowers spaced an average of 50 miles apart, the DEW Line project was completed in 32 months.

In the planning, Panero's men had to consider such factors as morale of future workers (which resulted in a separate room for every man, fluorescent lighting, hot showers) and permafrost (which meant all fuel lines, drains, and other pipes had to be laid above ground).

Water supplies are pumped to DEW Line stations from wells and lakes. The heat from the diesels

The huge riverside crane at Combustion's Chattanooga Division, capable of lifting loads in excess of 250 tons, is about to ease the reactor vessel into a 195-ft. barge which will transport it via the Tennessee and Ohio Rivers to Cincinnati. From there it will travel by rail to the Enrico Fermi Atomic Power Plant at Lagoona Beach, Michigan — 30 miles below Detroit.

AMERICA'S LARGEST NUCLEAR COMPONENT

The nuclear reactor vessel shown here is the most remarkable stainless steel pressure vessel ever built. This 36-foot, 92-ton giant is the container for the nuclear furnace that will power the world's first full-scale, fast-breeder reactor power plant — the Enrico Fermi Atomic Power Plant. Designed by Atomic Power Development Associates, Inc., the nuclear section of this plant will be owned by Power Reactor Development Co., and the turbine-generator section by Detroit Edison Co.

Because of its vast size and complexity, the reactor vessel presented unique problems of design and fabrication. In reality, it comprises four separate cylindrical vessels welded together to form a single unit assembly, plus a large amount of internal shielding the fabrication of which involved the use of 65,000 square feet of stainless steel — all constructed and assembled with a precision never before attempted in work of this size and character. Additional parts of the vessel, scheduled for later shipment, will bring its total weight to about 200 tons.

No more than two or three plants in the world presently have the skills and facilities even to undertake the production of work of this kind. Combustion not only has the men and machines, but also the experience to produce such reactor vessels. Moreover, it is equipped and qualified to design and manufacture all other major components of complete nuclear power systems.

The Enrico Fermi Plant exemplifies the continuing, urgent drive by electric utility companies to generate electricity at the lowest possible cost, utilizing all developments modern science and technology can produce. Combustion is proud to have shared in this major step of the power industry to prepare itself for the age of the atom.

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which drive the generators is trapped and utilized, with other areas heated by electrical units. Garages and hangars are heated by oil-fired space heaters.

Since DEW Line personnel are isolated during the long arctic winters, every emergency had to be anticipated. Two communications systems are available to station personnel when standard communications equipment fails. Standby power equipment is provided in all locations. And fire detection and alarm systems with extinguishing equipment for all types of fires are located throughout all structures.

Not Concerned With Defense Alone

Although many of his largest projects have been in connection with defense, Panero stresses the diversification of his firm. "We have specialized in air conditioning since the firm was founded. We also design power-generation facilities, boiler plants, electrical distribution systems, and sewage-disposal projects, and make technical surveys."

Panero's firm was the consultant for the U.S. Capitol power plant, the largest central station refrigeration plant in the nation. Built in 1910, this power plant received new steam-generating equipment in 1923.

Under a recent modernization program, the plant was converted into a large heating and cooling installation serving the Capitol building, the old and new House and Senate office buildings, and the Supreme Court building. (Steam only also is supplied to the Library of Congress, the Government Printing Office, and the City Post Office.) The entire program had to be planned, even to final connections, with no interruption of steam service or boiler shutdown.

Boy from the East Side

Born in the Piedmont, Italy Panero and his family moved to New York's East Side when he still was a teenager. The family landed in America in what would be termed "recession times" now. Money was scarce, and the family could not afford to send the children to college. To Panero, that did not mean he was to lack an education.

For nine years, Panero attended night school. During this time, he worked as a draftsman to pay his tuition. He not only gained a practical knowledge of engineering "on the board," but also studied mechanical engineering at Brooklyn Polytechnic Institute, and followed this with graduate studies in engineering at Columbia University and the City College of New York.

Panero joined Hegeman-Harris, Builders, in 1926, as chief of the mechanical department. His projects included Rockefeller Center, the New York Daily News Building, and the Chicago Daily News Building. Then Hegeman-Harris sent Panero and his family to Europe, where he was chief engineer for the American embassy buildings in Paris and London, the U.S. Pavilion for the Paris Exposition, and Earl's Court Exhibition Hall in London, the largest building (45-million cubic feet) in Europe.

Later, after Hegeman-Harris separated, Panero was a board member of John W. Harris Associates. He also has been a director for H. K. Ferguson Co., for whom he supervised construction of numerous war plants and arsenals during the War.

Offices in America and Europe

Panero's firm now has offices in New York, Washington, Paris, and Rome. He divides his time among the four, making a number of trips abroad every year. Current projects include a swimming-pool experimental reactor for the Israel Atomic Energy Commission and complete facilities in Rome and Paris for Pan American World Airways.

Panero, who gained an interest in engineering from his father, has inspired his own sons. Robert, 29, and Arthur, 27, are project engineers with their father's firm. Panero's daughter, Patricia, is studying music and voice.

Busy as engineering has kept him, Panero still has time for professional activities. He is a member of the New York Association of Consulting Engineers, the Architects League, and the American Arbitration Association. ▲▲

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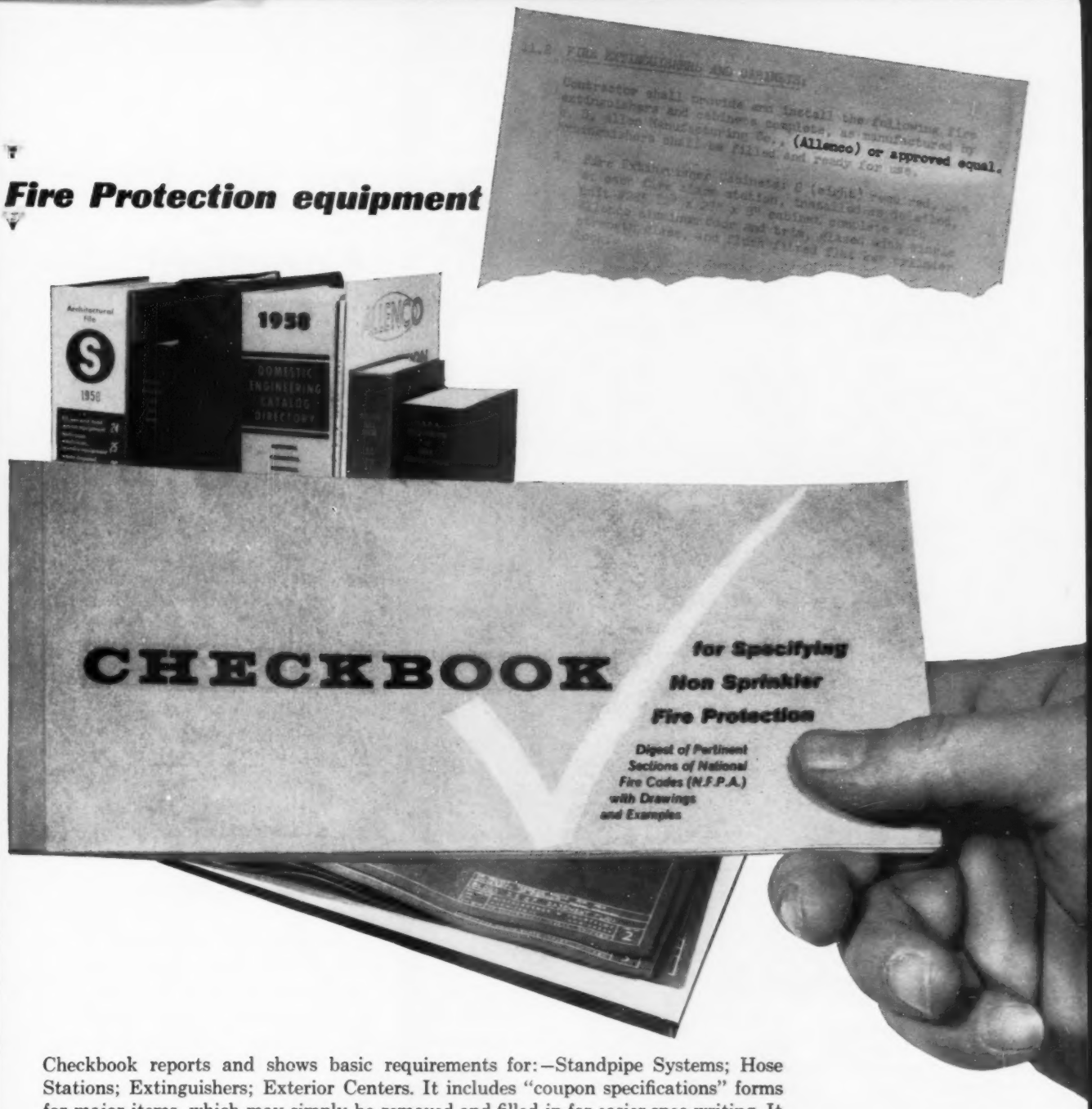
Fire Protection equipment



Checkbook reports and shows basic requirements for:—Standpipe Systems; Hose Stations; Extinguishers; Exterior Centers. It includes "coupon specifications" forms for major items, which may simply be removed and filled-in for easier spec-writing. It also lists references for details digested here.

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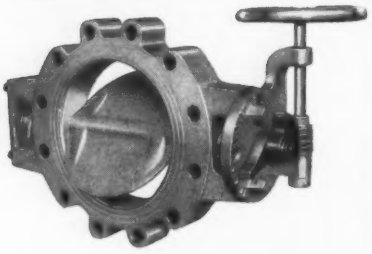

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- Standard sizes—4" to 36"; special smaller and larger sizes.

Bulletin 580 tells how they meet your needs.

W. S. ROCKWELL COMPANY
2468 ELIOT STREET
FAIRFIELD, CONN.

Readers' Comment

Request Granted

Sir:

I recall some 10 years ago, when the launching of your magazine, CONSULTING ENGINEER, was under consideration, a representative called on me and discussed the kind of publication which might appeal to the profession and the possibility of obtaining contributions from professional engineers in this organization.

Since that time I have received regularly copies of the magazine, sent to me without charge. I have enjoyed reading it and compliment you on your success in building up such a fine magazine. I find that I would have more time to read the magazine if it were addressed to my residence instead of to the office.

E. A. Dockstader
Stone & Webster Engineering Corp.
Boston, Mass.

European Tour

Sir:

All of the members of our Association who attended the lunch which you so kindly gave to them at the Dorchester on the 6th of May have asked me to write to thank you very much for your hospitality and to say how much they enjoyed it. Members have also told me that they were very pleased to have an opportunity of discussing various technical questions with their opposite numbers in your party and that they were glad in some cases to have had further discussions with them in their offices.

Everyone very much appreciated your kindness and the opportunity of making further contacts with consulting engineers from America. They hope that this happy association may continue in the future.

Colonel C. W. G. Walker, Sec.
The Association of Consulting Engineers (Incorporated)
London, England

Tax Savings Error of $13,298

Sir:

Reference is made to an article in your June '57 issue entitled "Increase Your Income With a Western Hemisphere Trade Corporation." On page 95 there is a box tabulation outlining the net tax saving through the use of such a corporation. In reviewing this calculation, we note a rather substantial error which we feel should be brought to your attention.

Under present law a U.S. corporation is subject to normal tax of 30 percent on total net taxable income. In addition, it pays a surtax of 22 percent on net taxable income in excess of $25,000. In the calculation presented by L. Wm. Seidman, the normal tax of 30 percent is computed on the first $25,-

000 instead of the entire taxable income. For our own purposes we have recomputed the tabulation and find that in the case of a Western Hemisphere Trade Corporation with taxable income of $50,000, the net tax saving is $9653 instead of $12,815, and with a taxable income of $100,000 the saving is $14,235 instead of $27,533.

After confirmation of our findings you may wish to bring this correction to the attention of your readers.

Edward Sands, Controller
Tippetts-Abbett-McCarthy-Stratton
New York, N.Y.

A Mere Slip of the Pen

Sir:

Unfortunately, Mr. Sands is right about the computations in connection with the Western Hemisphere Trade Corporation article. While the article itself was correct in describing how the computation was made, somehow an error in calculation was made.

I am extremely sorry that the error was made and assure you that this type of thing is not our usual manner of doing things.

L. Wm. Seidman
Certified Public Accountants
Grand Rapids, Mich.

* A CORRECTED TABLE IS AVAILABLE TO ANYONE WANTING A COPY.

Fresh Water

Sir:

In the February 1958 issue of CONSULTING ENGINEER, an article appeared entitled "Today's Price for Fresh Water from the Sea."

We would like to have as many as 1000 reprints of this article, or, if reprints are not available, your permission to reproduce the article (with proper credits to your publication). We would like to distribute such reprints as a free public information service of this Association.

William J. Mead, Exec. Sec.
Water Association of Kern Co.
Bakersfield, Calif.

ARROW AH HART

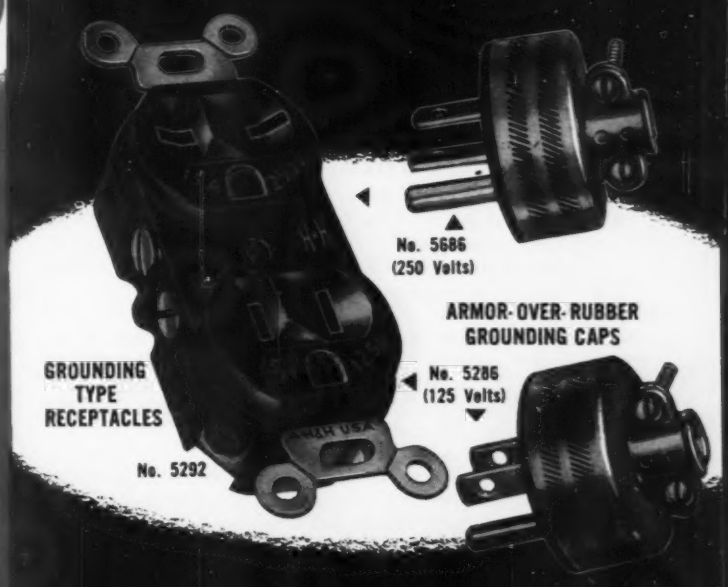
Do Your Plans include "grounding for safety ?"

Mr. Consulting Engineer: There will be portable electrical equipment used in every building — plant, office, school, hospital, etc. — you help plan. Protect this valuable equipment, and those who install, maintain and operate it, by specifying Arrow-Hart H&H specification grade receptacles, connectors and caps that assure proper grounding at all times.

We offer a free 12-page booklet which interprets the National Electrical Code requirements for grounding electricity for portable tools and equipment. Here is everything you need . . . technical information, pictures, diagrams, ratings, and catalog numbers . . . to simplify your specifying job.

Remember—Arrow-Hart's *complete* line of grounding type devices meets *every* safety requirement. Write for Grounding Booklet and our new Consulting Engineer's Specification Index to:

Dept. CE, The Arrow-Hart & Hegeman Electric Co., 103 Hawthorn Street, Hartford 6, Conn.



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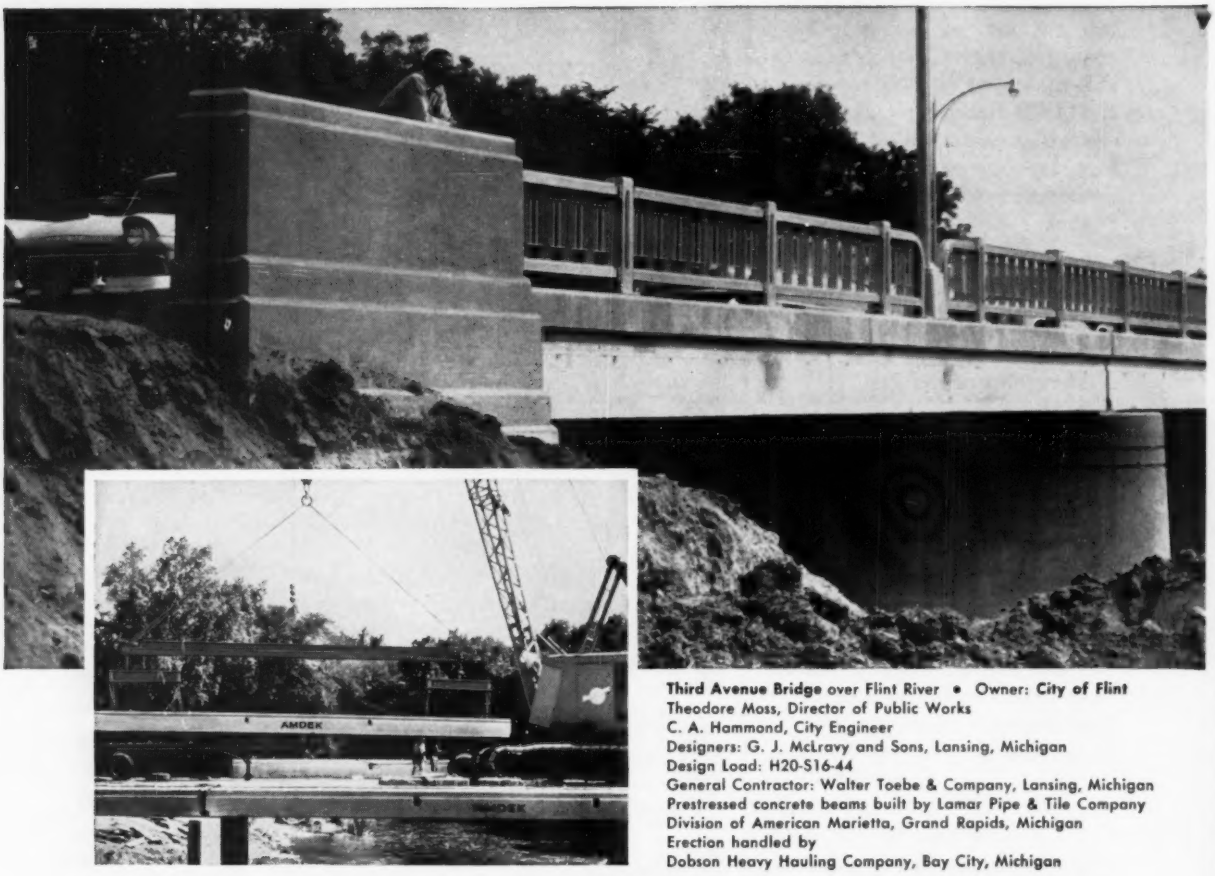
Prestressed Beams for 210-Ft.



Third Avenue Bridge over Flint River • Owner: City of Flint
Theodore Moss, Director of Public Works
C. A. Hammond, City Engineer
Designers: G. J. McLravy and Sons, Lansing, Michigan
Design Load: H20-S16-44
General Contractor: Walter Toebe & Company, Lansing, Michigan
Prestressed concrete beams built by Lamar Pipe & Tile Company
Division of American Marietta, Grand Rapids, Michigan
Erection handled by
Dobson Heavy Hauling Company, Bay City, Michigan

76 Beams Erected in 4½ Days with 110-Mile Haul!

The speed of prestressed concrete construction was dramatically demonstrated in the building of the Amdek Bridge at Flint, Michigan, shown under way in the photo above.

The 76 beams in this bridge went up in 4½ days. Said an observer: "I watched trucks pulling on the bridge. From the time one came to a stop and a girder was placed on the bridge, the average time elapsed was 12 minutes."

The prestressed components of this bridge were manufactured in just 20 days. It was estimated that well over a year would have been required for delivery of corresponding steel structurals.

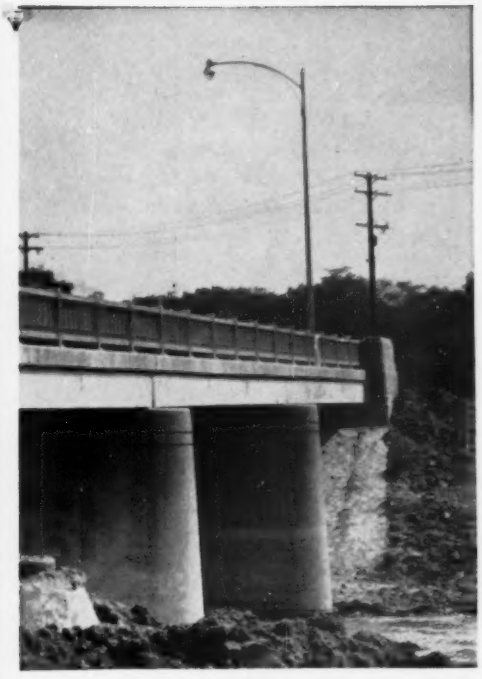
Advantages of Prestressed Concrete

Fast availability and speed of erection are only two of many advantages that make prestressed concrete the marvel of modern building materials. Prestressing increases tensile strength of concrete tenfold. Less concrete is needed. Strength-to-weight ratio is high. Longer spans and thinner sections are possible. Recovery after overloads is greatly increased. Prestressing gives the ideal combination of concrete's permanence PLUS amazing flexibility and elimination of cracking.

The adaptability of prestressed concrete is as unlimited as the imaginations of engineers and architects. Today it is being used in a range of applications from fence posts to giant bridges and multi-story buildings; from swimming-pool diving "boards" and movable parking lot curbs to airport runways and railroad snow sheds.

What triggered this trend to prestressed concrete? The development of practical, efficient tensioning materials. Union Wire Rope Corporation was a pioneer in this field. Today we're meeting the mushrooming demands for Tufwire high tensile wire and strand with on-schedule speed and dependability of supply. At the same time, we're gearing production facilities to the needs of tomorrow.

Bridge Made in 20 Work Days!



Highway Program Calls for 300,000 Bridges! How Will You Share in Supplying Them?

The vast national highway construction project assures a 15-years-plus market for bridges. Most of them can be built much faster and more economically with prestressed concrete than with any competitive building material.

It's history's biggest order for bridges. A giant demand for present makers of prestressed concrete. And a king-size opportunity for those who decide to go into prestressing business now.

For prestressed concrete construction answers this bridge need as nothing else can. In high degree of strength and permanence. Speed of construction. Savings in time and money. More profit for suppliers and constructors, and greater value for taxpayers.

Prestressing offers opportunities not only for the on-site contractor, but also for the contractor who would like to operate a permanent casting yard as an arm of his business or as a commercial fabricator. Opportunities in bridges. Opportunities in buildings of every kind. Opportunities in highway slabs, now in the advanced experimental stage.

If you're a present user of prestressed concrete, or engaged in making it, our engineering department and research laboratory will be glad to give you a lift with any prestressing problem or project.

If you're considering the establishment of a new prestressing plant to supply your area, let us help you explore the possibilities.

16-ton girder has just been lowered into place. The girders are 27" deep and 3' wide box section, tensioned with 28 3/8" Tufwire strands in the approach spans and 28 3/8" in the center spans. Overall width at the bridge is 60-ft.

Approach spans are 58'10", center spans 52'6". During erection, the bridge was subjected to 144 tons of live load carried on just 6 girders—far in excess of load in normal use.

The prestressed girders were built on the casting beds, partial view above, of the Lamar Pipe & Tile Company at Grand Rapids, and trucked 110 miles to the job site. The four spans of the bridge total 210-ft.

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The Reader's Guide

Theater Design

The average consulting engineer probably never thinks of the theater except as entertainment, nor does he consider the producer a potential client. But to Royce Emerson and Louis Kennel, the theater not only could, but should, be using consulting engineers. The stage designer – theatrical equivalent of an architect – knows his business esthetically, but he needs help on mechanical, electrical, and structural work. The theater is not likely to become any consultant's major source of income, but it is, as the authors say, a field where the consultant has much to contribute. To find out about some of the opportunities, see "Theater Stage Engineering – A New Field For The Consultant," starting on page 92.

Piling Problems

While corrosion is more prosaic than the theater, it is fully as challenging to the engineer. As Benton C. Lattin, of Ebasco Services Incorporated, points out, the problem of sea water corrosion has not been licked, but it can be controlled. Lattin has gone halfway around the world – from Liberia to the Philippines – to study the ravages of corrosion first hand. His report, "Steel Piling in Sea Water," describes the use of cathodic protection to inhibit corrosion of steel piles and discusses methods to preserve wood pilings. It begins on page 78.

Static Analyses

Structural engineers now can use a remarkable device to simulate stresses on frames and trusses. A simulator has important advantages over conventional analog and digital computers, for the simulator is based on the equivalence between structural forces and corresponding power theorems in electric networks. Having 20 years' experience with such electromechanical devices, Frederick Ryder is particularly well qualified to describe their applications, simplicity, and accuracy. "A Structural Simulator For Static Analyses" starts on page 84.

Aids for Preparing Specifications

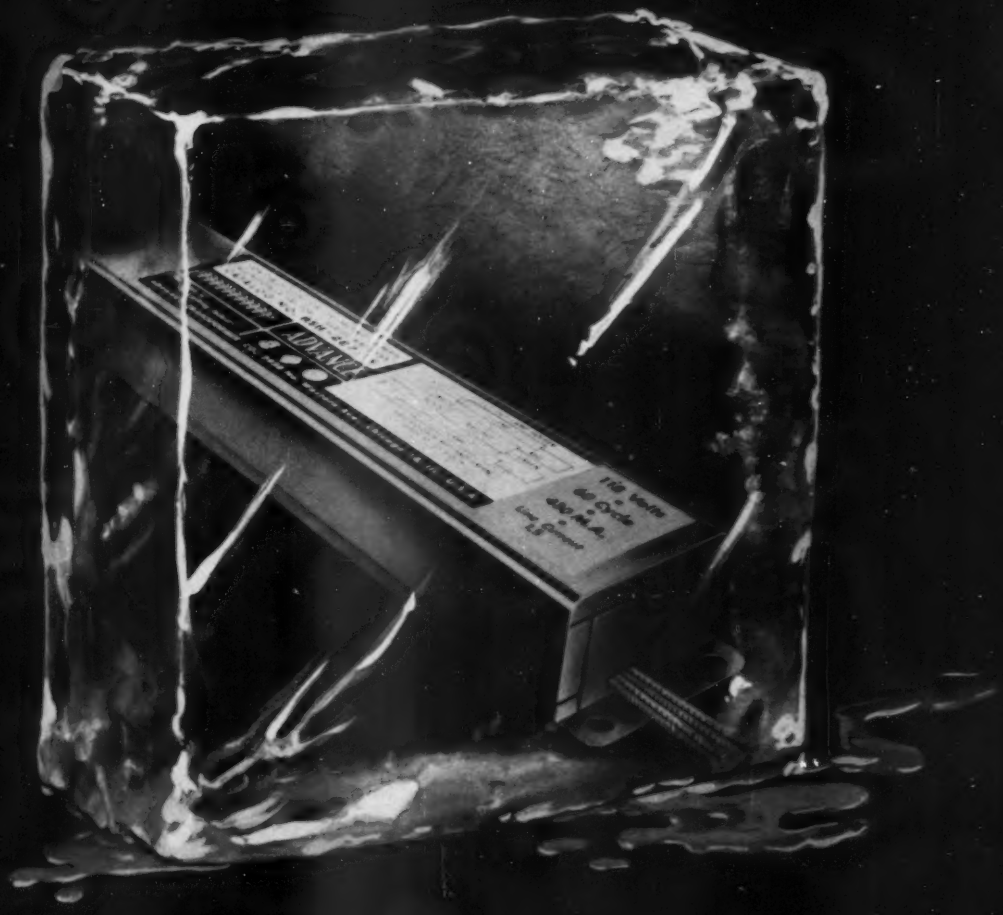
Unlike Mr. Ryder, Arthur L. Spaet does not have a magic "box" to help him do the dreary, tedious, repetitive job of writing specifications. But the system he has developed works well at Slocum & Fuller (where it has slashed the writing time of project engineers 75 percent), and should work equally well for consulting engineers everywhere who write specifications. A "must" for every consultant, Spaet's "Standard Worksheets . . . For Tailored Specifications" begins on page 100.

Soils Engineering

Because highways can be no better than the soil they are built on, the importance of soils engineering is growing steadily. By examining and testing the substrata, the soils engineer can give the consultant the data he needs for his designs. David M. Greer, who has been in soils engineering for 20 years, explains the procedure in "Soils Engineering . . . Its Role in the Interstate Highway Program." The article is based on his experiences investigating soils for such projects as bridge foundations and superhighways. It starts on page 108.

Selling Public Clients

This month the Committee of One-Hundred turns to the problem of how the consulting engineer can sell his services to the public client group. Here the consultant has a real problem for many government engineering departments would rather expand their staff than hire outside help. What arguments can the consultant use to counteract this trend? How can he show public officials it is to their best interests, and the best interests of the body politic, to engage private consultants? What is the best approach to Federal, state, and local governments? Experience-tested answers to these and other questions will be found in the Committee's report beginning on page 114.



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eliminates use of costly radiators

TECHNICAL DATA—ADVANCE KOOL KOIL BALLAST—CAT. No. RSH-2E75-S

CATALOG NUMBER	LAMP TYPE	NOMINAL LAMP WATTS	RATED LAMP CIRCUIT M.A.	CIRCUIT VOLTAGE	LINE CURRENT (AMPS)	WATTS LOSS	OPEN CIRCUIT VOLTAGE	DIMENSIONS IN INCHES			
								LENGTH	WIDTH	HEIGHT	MOUNTING
RSH-2E75-S	(2)F96T12	74	430	118	1.5	24	775	14 5/16"	3 7/64"	1 25/32"	13 1/4"
	(2)F72T12	55	430	118	1.5	24	775	14 5/16"	3 7/64"	1 25/32"	13 1/4"

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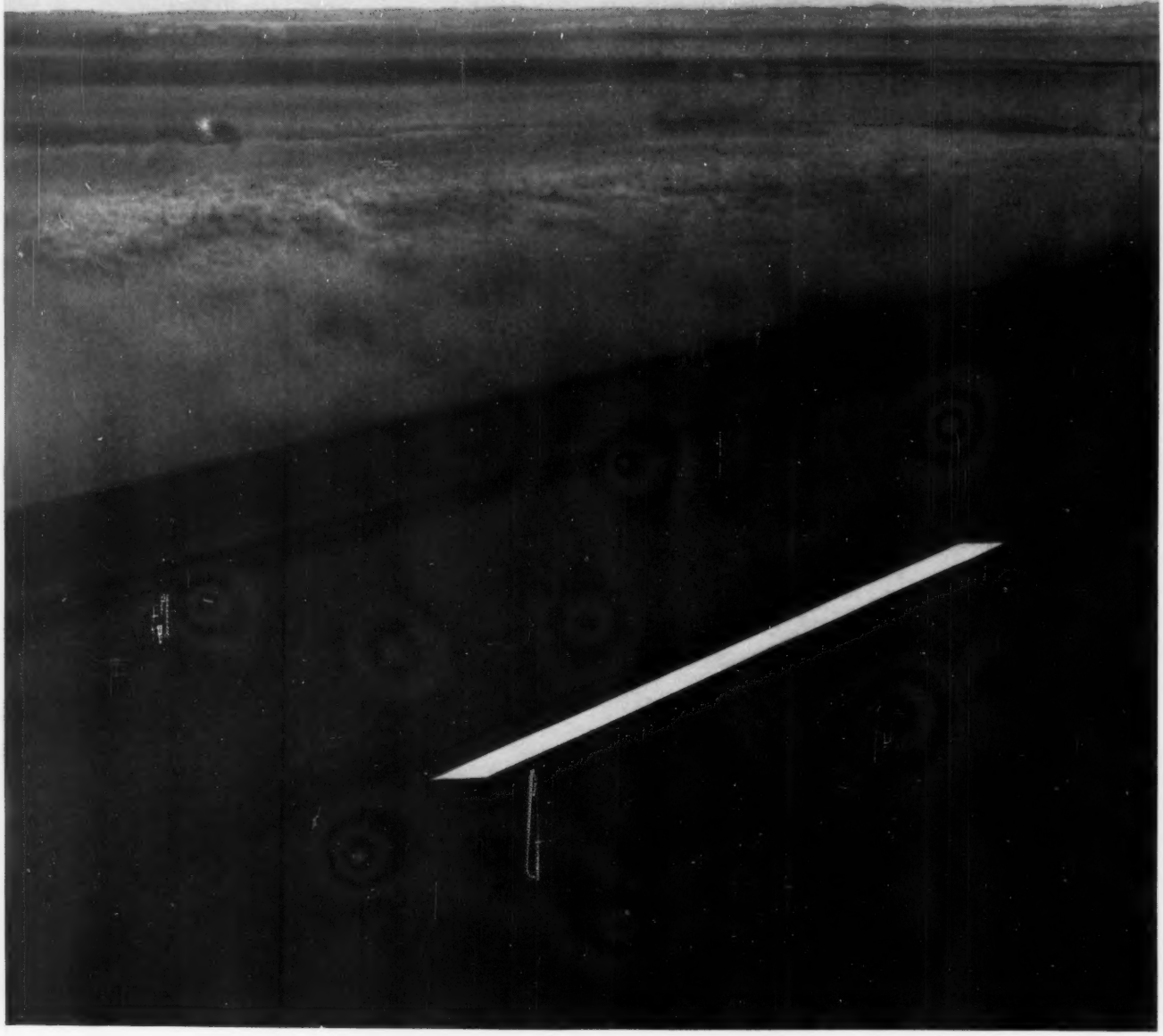
Saved...$48,348 a mile...



Heavy-duty ASPHALT pavement on Interstate highway saved North Dakota an estimated $600,000■■■■■■■

■■■■ For the 12.092 mile two-lane Valley City East section of U. S. Highway #10, the State of North Dakota chose modern Asphalt paving *(12" gravel base, 5" Asphalt pavement).*

This decision saved an estimated $48,348 *a mile* on initial costs alone, compared to bid costs on two lanes of nearby slab-paved section.

"We feel Asphalt paving is superior," said Mr. Ronald Megarry, Megarry Brothers Construction Co. "It not only costs less to lay than rigid type paving but also less to maintain."

Modern Asphalt construction has saved state after state up to 10% . . . and sometimes up to 50% . . . on paving costs alone.

with rugged ASPHALT paving!

And, in one impartial report, 7 out of 10 states said that heavy-duty Asphalt paving costs less for maintenance. On the New Hampshire Turnpike, for example, maintenance costs have been only $36.07 a mile, per year.

In winter, snow melts faster, making Asphalt pavements safer. And Asphalt paving is not harmed by de-icing chemicals. Also, heavy-duty flexible Asphalt pavement stands up in temperature extremes.

For maximum economy, comfort and road life . . . at minimum cost . . . make sure your new Interstate Highways are Asphalt-paved. *You* can bank on their permanence.

The ASPHALT Institute, *Asphalt Institute Building, College Park, Maryland*

Ribbons of velvet smoothness . . **ASPHALT**-paved Interstate Highways

Scraps & Shavings

PROFESSIONAL ETHICS is the most discussed and the least understood aspect of private practice. Perhaps the major misunderstanding comes through a confusion of personal ethics with professional ethics. They may sound as though they mean about the same, but they have little to do with each other.

If you cheat your brother out of his birthright, you are personally unethical – but you might be the most professionally ethical engineer in town.

If you get a contract for a project by stepping in and underbidding another consultant, you are professionally unethical – but your personal ethics may be impeccable. Price competition, in itself, is the very heart of the private enterprise system. It is not only honest, it is essential to our economy. It is unethical only within the professions.

It should be understood that professional ethics is not among the homilies learned at mother's knee. It is not taught in the churches.

Professional ethics is a very special set of rules, established by a particular group, setting forth principles of practice under which it, and it only, agrees to operate. A professional code does not define a good way of life. Instead it indicates the ways in which the proper practice of a profession differs from the general ethical code of mankind. It says, in effect, "In these ways we are different from other men."

Unfortunately, engineers in private practice do not have a satisfactory published code of ethics. There are now three codes available to consultants: the Canons of Ethics, which are accepted by most of the engineering societies; the Code of Ethics of the American Society of Civil Engineers; and the Code of Ethics of the Consulting Engineers Council. Of these, the Code of ASCE is by far the best for consultants, for it deals directly with ethical questions faced regularly by engineers in private practice. The Canons are next in order of value, but they suffer from vague idealism and too little clear-cut definition. The current Code of the Council is a poorly thought-out piece, unworthy of serious consideration.

Even the best, the ASCE Code, is less than the consulting engineer needs. It is out of date, weakened in some parts, and fails to even mention many important aspects of professional ethics.

We need a new code.

Not only that, we need a good textbook dealing with every aspect of that code; a text that gives examples and discusses all of the nuances and all of the grey areas; a textbook that permits the study of professional ethics in just the way good texts permit the study of statics or thermodynamics. Then, the student engineer could be given a course in professional ethics. The practicing engineer could have a reference book that would indicate with authority what is and what is not ethically acceptable practice.

It is possible to prepare a good code of ethics, and it is possible to write and publish a textbook covering it. These projects should be started now.

Perhaps they will be. Charles Pate, new president of the CEC, said in his inaugural address: "I have read the codes of ethics of several organizations. After reading these codes, I am impressed with the high-sounding phraseology and idealistic approach for the government of the members' activities, but when they are digested I often wonder what does all this mean in definite rules governing their actions. I believe we should be realistic and accept the fact that most violations of codes of ethics are due to a lack of understanding of their specific meaning rather than the willful desire to take an advantage of our colleagues. I suggest that our ethical practice committee set up a detailed code of ethics, spelling out in plain terms what is intimated but never specified in other contemporary codes."

If the Council can write such a code, it will have done more for the profession than any organization has done in this century. ▲▲

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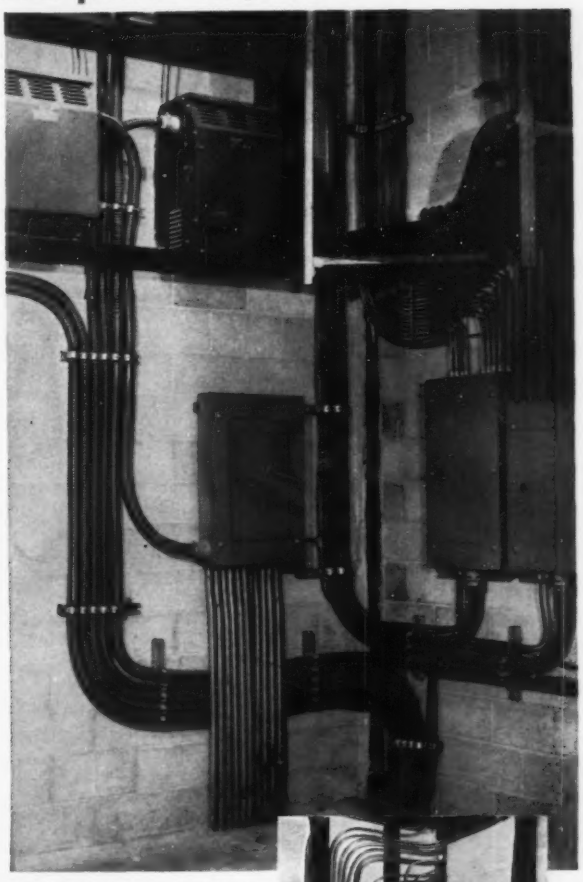
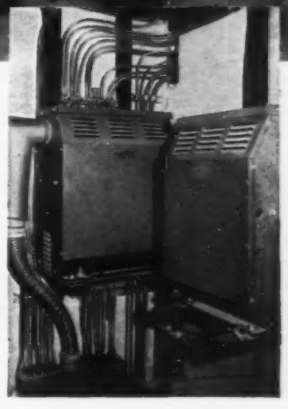


Installation at the St. Regis Paper Company, Jacksonville, Fla. plant.



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Easy to install in all locations, both Safety MI Cable and Interlocking Armored Cable require no mechanical protection, thus lowering costs of installation and minimizing space requirements. These constructions are easy to train around equipment or structural members, assuring the absolute minimum of interference, and present a neat, functional appearance. In addition, Safety MI Cable has unequalled physical and electrical properties: it is completely resistant to moisture, aging, nearly all chemicals, and operates at continuous high temperatures. For truly modern wiring in your plant, specify Safety MI Cable and Interlocking Armored Cable. And remember; only General Cable makes them both.

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Ford shifts

to coal for low-cost steam

Coal proves economical and easily available for steam generation at Ford's Louisville plant

Assembly Plant #2, Ford Division—Ford Motor Company, Louisville, Ky., was constructed in 1954. Because of the importance of steam for process work and heating, Ford's engineering department—working with the consulting firm of Albert Kahn Associated Architects and Engineers, of Detroit—conducted a fuel survey before the power house was designed. Object: to find an economical and efficient fuel.

Result: *coal* is used because of its *continuous* plentiful supply and advantageous price. Today this advanced coal-burning installation produces a reliable supply of low-cost steam. Only routine maintenance has been required and the cleanliness and general efficiency of this steam plant are considered among the outstanding features of its operation.

Facts you should know about coal

You'll find that bituminous coal is not only the lowest-cost fuel in most industrial areas, as in the case of Ford's Louisville plant, but up-to-date coal burning equipment can give you 15% to 50% more steam per dollar. Today's automatic equipment can pare labor costs and eliminate smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at stable prices.

Technical advisory service

All companies planning a new power plant, or the remodeling of a present one, should consult an engineering firm on its design and construction as Ford consulted the Albert Kahn firm. As a matter of fact, every Bituminous Coal Institute advertisement advises its readers to take this step. When you have such a project, our Engineering Staff will be glad to assist you in your fuel cost survey with any coal information you may require.

Meanwhile, we believe you will be interested in our informative case history booklet, complete with data sheets. Write to the address below for your copy.

BITUMINOUS COAL INSTITUTE

Dept. CE-06, Southern Building, Washington 5, D.C.

Firing aisle, shows Boiler #1 in right foreground. This is 60,000 lb/hr unit, using a two unit spreader stoker; Boilers #2 and #3 have capacity of 120,000 lb/hr and use four feeders. All three boilers are by Wickes Boiler Co., Type R, operating at 125 psi, 350 degrees F, fired by American Engineering "Perfect Spread" stokers.

Showing National Car Shaker being used to expedite emptying of cars. Dustless ash removal system in background.

Beaumont Birch Steam Vacuum System draws ashes through pipes to outside ash silo for removal. View is at basement level, below boiler room floor. Coal handling system also by Beaumont Birch Co.

Mechanical dust collectors are by Prat-Daniel Corp. Fly ash handling system removes ash from collectors and boiler passes.

The Word from Washington

EDGAR A. POE
Consulting Engineer Correspondent

THE OFFICE OF SALINE WATER is stepping up its engineering research and pilot plant operations to reduce costs of converting sea water into fresh water. So far laboratory and economic studies have been narrowed to five broad groups: distillation through artificial heat; solar heat distillation; salt separation by two or three types of membrane processes; freezing; and other chemical or electrical means.

Interior Secretary Fred Seaton says it is questionable whether radical or sudden technological advances will bring a drastic drop in the cost of conversion. Seaton says commercial use may begin when the cost is brought to $1 per 1000 gallons, and some municipal use may be expected when the cost drops to 50 or 60 cents per 1000 gallons.

Interested engineers can get seven reports on saline water research from the Office of Saline Water, Interior Department, Washington, D.C.

Road Program Engineering Up

More funds are being spent this year for engineering and right-of-way acquisition for the highway construction program than in 1957, the Bureau of Public Roads says. Estimated 1958 expenditures are $1.3 billion. These will rise sharply in 1959.

The Federal Highway Act of 1958 suspended the "pay-as-you-go" provision incorporated in the 1956 Act. Money now will be appropriated out of the general Treasury funds to the Highway Trust Fund.

The stepped-up authorizations and the temporary release of the Highway Trust Fund from its pay-as-you-go stipulation is a boon to the entire highway industry, but it puts the industry in a position of getting what it can from the Treasury. Meanwhile, the industry sharply assails any attempt to divert funds from the Highway Trust Fund to any other government agency.

New Nuclear Subs

Three nuclear submarines abuilding at Mare Island Shipyard in California will be assigned to the Pacific fleet upon completion. The first, the Sargo, is scheduled to be commissioned in October. Another, the Halibut, a guided-missile submarine, will be commissioned in December. The third will be christened the Scamp. The world's first nuclear submarine, USS Nautilus, has been with the Pacific fleet this spring to familiarize fleet personnel with nuclear craft.

Want Work Overseas?

Consulting engineers interested in projects abroad are keeping an eye on the International Finance Corporation. IFC, an affiliate of the World Bank, is an investing institution dealing directly with private business. Established nearly two years ago to promote economic development in areas needing capital for major productive ventures, the agency is looking toward Latin America and Africa. Thus far the agency is putting an average of about $2 million into each investment project in countries with substantial natural resources.

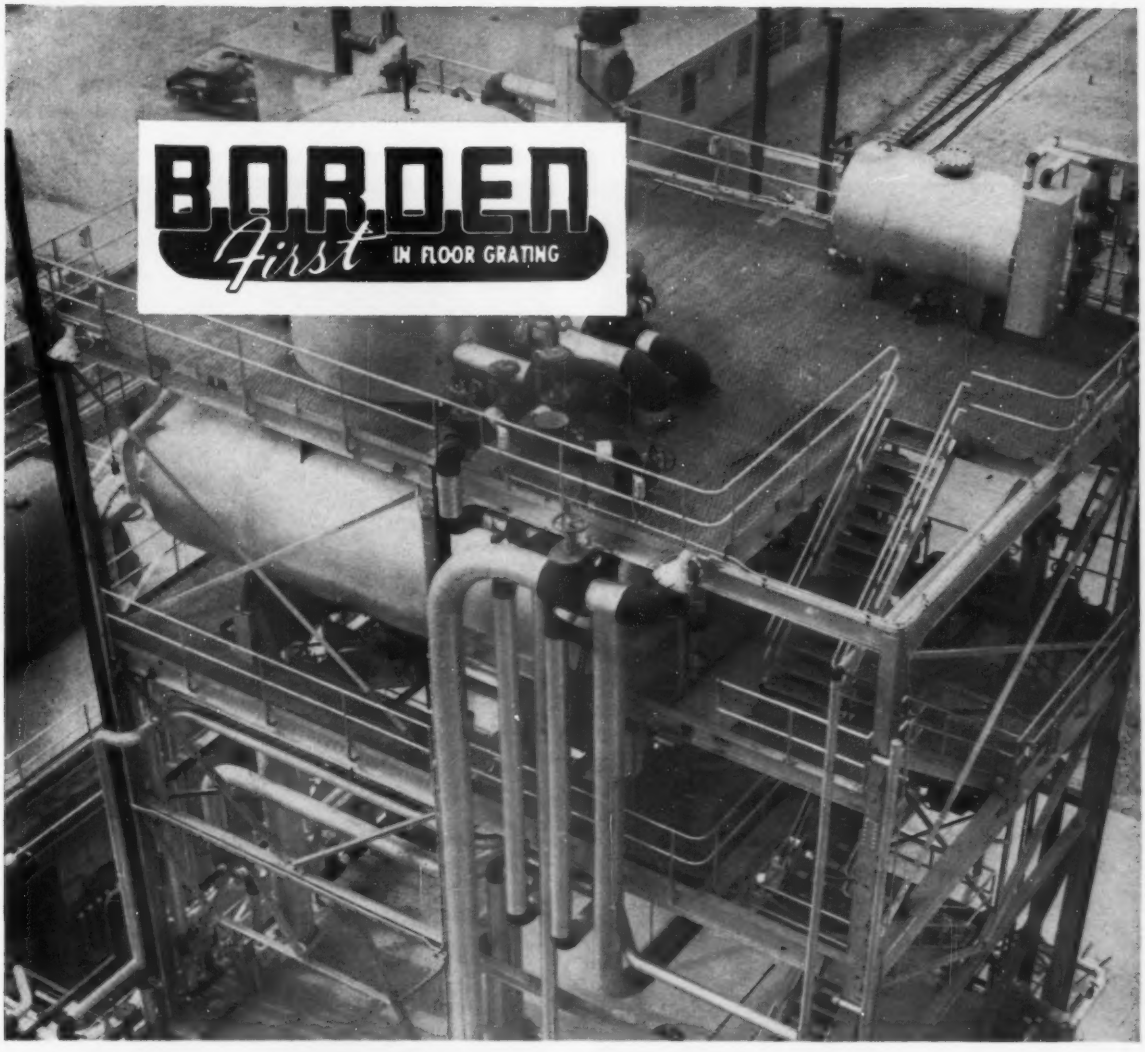
Air Conditioning is Booming

Morris Shapiro, Washington, D.C. consulting engineer, says air conditioning is becoming increasingly important. All Federal government buildings being constructed, including the many proposed new post offices, are designed for air conditioning. More than 4-million homes in the United States have some air conditioning now. In fact, southern home builders have begun putting central air conditioning in $10,000 and $12,000 homes. Experts foresee an ever-rising demand for air conditioning – and therefore electric power – in the United States for the next 15 years at least.

NRECA Activity

The National Rural Electric Cooperative Association, representing nearly 1000 rural electric systems, is appealing to Congress to loosen its purse strings so that construction can start on some multipurpose river projects.

Highlights from NRECA's proposal include: immediate starts on seven new projects already authorized by Congress; accelerated planning for five projects; and accelerated construction schedules for 20 projects now under way. ▲▲



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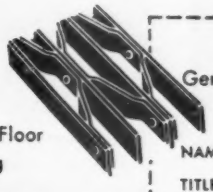

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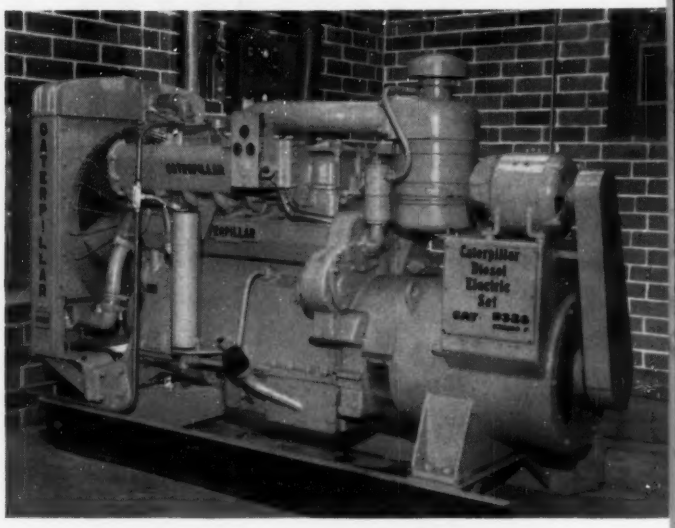
A Cat D375 Diesel Electric Set, running alternately with two Cat D13000s, supplies all power and lights at the State Line Hotel, comprising a 16-unit motel, 50-room hotel, filling stations, restaurant and cocktail lounge. Says Gene Jones, manager: "We think Caterpillar sets are very economical and most dependable, and our dealer service is good. One of our Cat D13000s has run more than 44,813 hours on the original main bearings!"... Obviously, Cat Diesel Electric Sets are economical prime power units, and function as economical and dependable emergency units capable of carrying a large power load.



This Cat D326 Diesel Electric Set serves as emergency power for the 100,000-watt WFBC-TV transmitter at Greenville, South Carolina. Cat Electric Sets are automatically started, cutting in within seconds, and have the ruggedness to run indefinitely in times of prolonged emergency. Cat Diesel Engines operate on widely available types of furnace fuel, whose low combustion makes them a desirable safety factor in hospitals particularly.... Caterpillar will have a Standby Power Catalog in Sweet's Architectural File for 1958. We will be glad to send an advance copy of this catalog at no charge (just fill out the coupon on next page).

The 175-bed Yakima Valley Memorial Hospital in Yakima, Washington, relies on a Caterpillar D326 Diesel Electric Set for insurance power. In case of commercial power failure all critical requirements can be filled by this Cat unit. Commercial power interruptions totaled 13 in two years, and the D326 supplied power for elevators, X-ray units, diet kitchens, laundry, boiler rooms, operating suites, heating and air conditioning, etc.

A Cat D397 Electric Set is used for emergency power in case of a commercial power failure to insure power for this 16-floor Miami Beach Federal Building at Miami Beach. A wide variety of office buildings, hotels and industrial plants have found it both economical and good public relations to provide emergency power *that can be depended on no matter* what happens to normal power channels.

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The trend today is to make provision for *emergency power* in your building plans. More and more, your clients expect you to insure them against costly, temporary loss of commercial power. The number and variety of structures—in almost every phase of business—which should have emergency power designed into their installations, is increasing.

Many responsible architects are serving their clients' best interests by specifying emergency power by Caterpillar. CAT Diesel Electric Sets have an unsurpassed reputation for dependability and high-quality generators. Call your Caterpillar Dealer Installation Engineer today for help in giving your clients the best power protection available.

Engine Division, Caterpillar Tractor Co., Peoria, Illinois, U. S. A. Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

A Cat D326 Electric Set provides emergency power for transmitter station WFBC-TV atop Paris Mountain, Greenville, South Carolina. Even a brief interruption of commercial power can cost a television station enough to pay for its Cat Electric Set in forfeited billings, and the loss of prestige. For these reasons television stations all over the country are installing Cat emergency power protection.

ENGINE POWER BY CATERPILLAR

NOTE: Increasingly, both small and large hospitals are insisting on emergency power units. It's significant that hospitals meeting certain general requirements (which most hospitals everywhere do meet) are entitled to Federal aid in financing emergency power installations (note coupon).

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- ☐ Please send me one advance copy of Caterpillar's Sweet's Catalog File for 1958.
- ☐ I would like more information concerning Federal aid for emergency power unit purchases.
- ☐ Please ask a Caterpillar Dealer salesman to call on me as soon as possible.

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The Legal Aspect

MELVIN NORD, P.E.
Consultant in Legal and Technical Problems
Patent Attorney

Ownership of Real Property – High and Low

IN THE LAST TWO ARTICLES in this series, we considered some of the problems relating to the determination of surface boundaries of land ownership. But after one has determined where to place his "fence," so to speak, the next questions are how high *above* the surface, and how low *below* the surface does his "fence" go? In other words, what are his property rights in the third dimension?

Obviously, three-dimensional persons cannot live in a two-dimensional world. Ownership of land on the surface only would be less than superficial. No man would have a right ever to stand up on his own land, unless his ownership extended above the surface. And he could not erect any substantial buildings or utility services unless he had subsoil rights as well. Thus, ever since land ownership has been recognized at law, it has included a third dimension.

The Romans Had Some Words For It

At the common law, over the centuries, this idea was expressed by the Latin maxim "*cujus est solum, ejus est usque ad coelum et ad inferos.*" In Latin, this sounds good but it could never really be the law when translated into English – "the owner of the soil owns to the heavens and also to the lowest depth." When nobody could dig very deeply into the ground, or get very high, no harm was done by reciting the maxim (especially in Latin), but nowadays, things are different. Now that we really can get to heaven or hell, it makes a difference whether someone else has legal title and can exclude us from such places.

It is therefore necessary to consider the questions of how high up and how low down the ownership of land really goes. Let us start from the bottom (as usual), and work our way up.

How Low Can a Man Go?

The ownership of land includes the *contents* of the land on the surface and below; for example, ice, growing crops, orchards, and minerals. Thus, the owner has a right to exclude others from access to subsurface minerals, and to prosecute miners who without authority enter his land below the surface to remove minerals.

Similarly the owner of land has been held to have an action of trespass against a person who unauthorizedly constructed a tunnel beneath his

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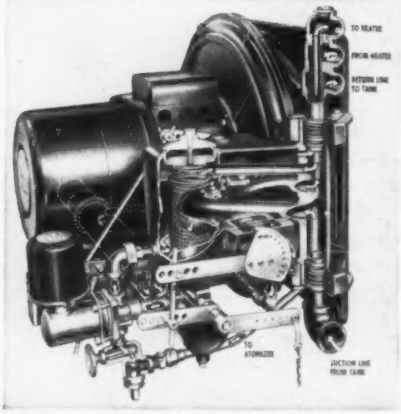

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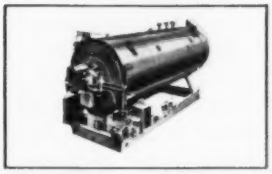
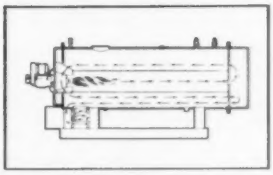
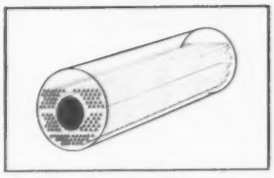


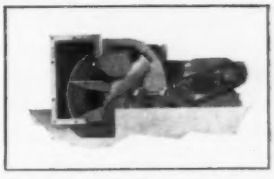
● **A complete package** including boiler burner, draft equipment, controls and all interconnecting piping and wiring. Completely assembled and factory fire-tested.



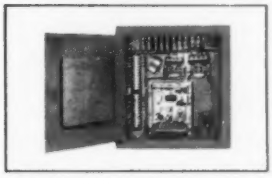
● **4-pass down-draft** design, promotes rapid water circulation. Decreasing tube volume in successive passes provides high combustion gas velocities and maximum heat transfer.



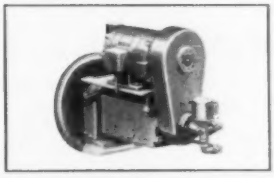
● **5 sq. ft.** of heating surface per b.h.p. Units reach conservative ratings with ease. Guaranteed thermal efficiency 80%. Stack temperatures not exceeding 125° above steam or water.



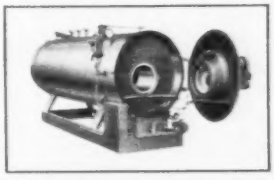
● **Induced draft** operating at relatively slow speed results in unusual quiet plus safety from danger of forcing gases out into boiler room. Negative furnace pressure also protects refractory.



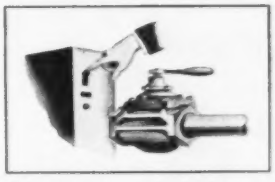
● **Fully automatic** operation firing oil, gas or both. Firing rate adjusts to demand, never overfiring wastefully, but handling sudden increases without lag. Variety of controls available.



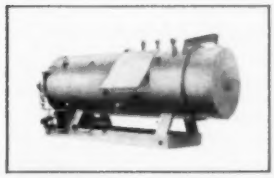
● **Superior Rotary Burners** on all sizes firing No. 4, 5 and 6 oil. Most dependable type of equipment ever devised for burning heavy oils. Burners require minimum supervision, and no lubrication.



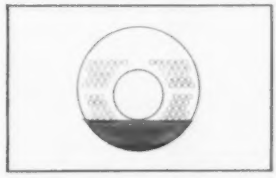
● **Hinged** front and hinged or davited rear door on all units. Doors may be opened simply without removing refractory and are simply and effectively sealed with standard asbestos rope.



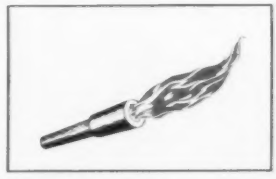
● **Instantaneous fuel changeover.** Units equipped for oil and gas firing may be changed from one fuel to another quickly and simply by operating only a switch and a valve.



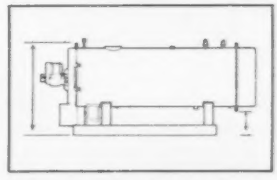
● **Completely insulated** and jacketed. Even the bottom of the boiler shell is covered with 2" insulation. No uninsulated areas for heat loss and unnecessary heating of the boiler room.



● **Down-draft design** places furnace high in shell, safely away from danger zone . . . completely eliminates bagging and blistering resulting from mud build-up in bottom of boiler.



● **Constant gas pilot** remains lit at all times, prevents accumulation of gas in the furnace which could result from even an almost undetectable leak in the gas valve.



● **Low total height** but with clearance from floor allows ample room under the shell for inspection, maintenance and installation of piping. The COMPACT is practical as well as compact.

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land. Even an adjacent subsurface foundation which projects across (or under) the boundary line constitutes a trespass and generally can be enjoined. Similarly, it has been held to be a trespass to drive earth under the soil of another. All this is in accord with the Latin maxim, but obviously does not prove its validity.

The application of the maxim reached its peak (or depths) in a Kentucky case, in which the surface owner was permitted to recover for trespass in a cave extending under his property, 360 feet below the surface, to which he had no access from his land. This decision has been characterized as "cave-man" law, and has not been followed in a New York case which held that a sewer 150 feet below the surface was not a trespass. The latter case definitely is regarded as the correct view at the present time, although authorities are very skimpy either way.

It is believed that the correct analysis of such cases is to decide whether the activities of the surface owner are such (or, perhaps, can be expected to be such) that he may be said to be "in possession" of such subsurface space with intent to exclude others (since that is the general definition of ownership of anything). If the space in question is clearly outside his control, it is not sensible to say that his "rights of ownership" have been violated. No doubt, in close cases, the benefit of the doubt normally must be given to the surface owner, on the theory that he has had it under such possession as was warranted under the circumstances. But that does not mean he owns the subsurface in any way different from the way he can own anything, by possession with intent to exclude others.

Obviously, this does not give a very precise lower bound to his property. However, the mere fact that questions of trespass are to be determined by the applications of common sense and fundamental legal principles, instead of by surveyors, is not enough to relegate the modern view "to the lowest depths."

How High Can a Man Get?

When it first was discovered that man could fly, it was a distinct nuisance to lawyers, especially to those who knew Latin. For it was obvious that substantially every airplane was bound to be "trespassing" over the land of others most of the time.

Since there have been many such cases, it very definitely can be said that the law of this subject has worked itself into an extreme state of confusion. (However, this is better than the state from which it started, which was a state of stupor.) One thing is clear, however, and that is that the Latin maxim may be "for the birds," but

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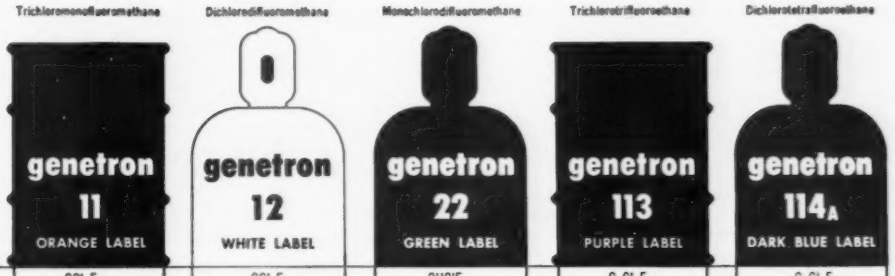

Selected Physical Data (Performance based on 5°F evaporator temperature and 86°F condenser temperature)	Trichloromonofluoromethane genetron 11 ORANGE LABEL	Dichlorodifluoromethane genetron 12 WHITE LABEL	Monochlorodifluoromethane genetron 22 GREEN LABEL	Trichlorotrifluoroethane genetron 113 PURPLE LABEL	Dichlorotetrafluoroethane genetron 114A DARK BLUE LABEL
Chemical Formula	CCl_3F	CCl_2F_2	$CHClF_2$	$C_2Cl_3F_3$	$C_2Cl_2F_4$
Molecular Weight	137.4	120.9	86.5	187.4	170.9
Boiling Pt. (°F) at 1 Atm. Pressure	74.7	—21.6	—41.4	117.6	37.6
Evaporator Pressure at 5°F (p.s.i.g.)	24.0*	11.8	28.3	27.9*	15.6*
Condensing Pressure at 86°F (p.s.i.g.)	3.6	93.3	159.8	13.9*	22.7
Freezing Point (°F) at 1 Atm. Pressure	—168	—252	—256	—31	—76
Critical Temperature (°F)	388	234	205	417	294
Critical Pressure (p.s.i. absolute)	635	597	716	495	478
Compressor Discharge Temperature (°F)	112	101	131	86	88
Compression Ratio (86°F/5°F)	6.24	4.08	4.06	8.02	5.33
Specific Volume of Saturated Vapor at 5°F (cu. ft./lb.)	12.27	1.46	1.25	27.04	4.04
Latent Heat of Vaporization at 5°F (B.t.u./lb.)	84.0	68.2	93.6	70.6	60.2
Net Refrig. Effect of Liquid—86°F/5°F (B.t.u./lb.)	67.5	50.0	69.3	53.7	43.0
Specific Heat of Liquid at 86°F (B.t.u./lb.-°F)	0.21	0.24	0.34	0.22	0.23
Specific Heat of Vapor at Constant Pressure of 1 Atm. & 86°F (B.t.u./lb.°F)	0.13	0.15	0.15	0.15	0.16
Specific Heat Ratio at 86°F & 1 Atm. (k = Cp/Cv)	1.14	1.14	1.18	1.09	1.01
Coefficient of Performance	5.09	4.70	4.66	4.92	4.60
Horsepower/Ton Refrigeration	0.927	1.002	1.011	0.960	1.025
Refrigerant Circulated/Ton Refrig. (lbs./min.)	2.96	4.00	2.89	3.73	4.65
Liquid Circulated/Ton Refrig. (cu. in./min.)	56.0	85.6	68.0	66.5	88.7
Compressor Displacement/Ton Refrig. (c.f.m.)	36.32	5.83	3.60	100.76	18.78
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Flammability & Explosivity	None	None	None	None	None

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it does not govern the relations between one man and another.

Two Theories Advanced

While the cases show but little consistency, there really are only two basic theories in current application. The first is that man really does own "to the heavens," but that any one who wishes to fly over his land has a right of flight (like a right of way over a street), so long as he does it at a sufficient height to avoid committing a nuisance. The second view is similar to the one described above for subsurface rights, i. e., that "ownership" extends only to the region of "effective possession;" above this height, liability only can exist if a nuisance is committed (for example, unreasonable interference with the use and enjoyment of the land), but there is no automatic trespass action. There is not really much difference between these two theories, although it is perfectly obvious that the first theory cannot really be correct. It contains an inner inconsistency in connection with the international aspects of the law of flight. Nevertheless, about half the states have adopted it, usually by statute, for reasons which will become clear.

International Aspects of Flight Law

As indicated above, about half the states have been reluctant to "give up" their "ownership" of the heavens. The reason for this is not because they are trying to preserve valuable "property rights" for individuals, but because of its applications in public law – particularly international law.

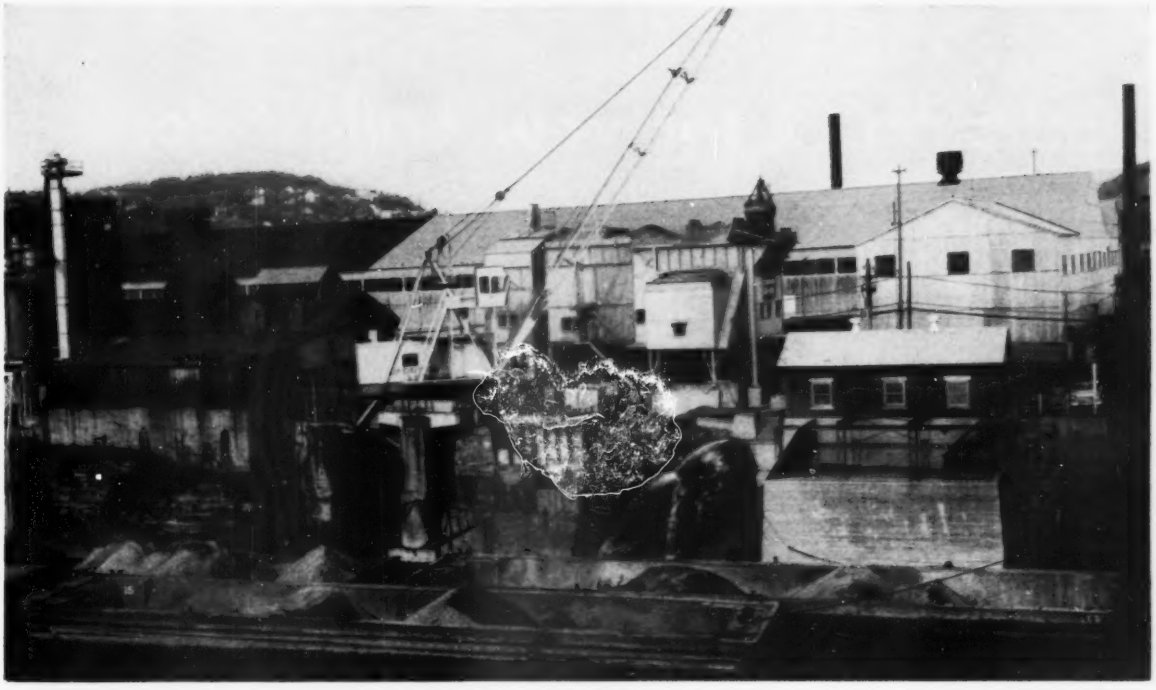
Every state or country seeks to "preserve" its "rights of ownership" over the space above it to be able to exercise some control over flights from foreign states or countries. Thus, the states and countries have met the space age not with an enthusiastic search for methods to use space for the betterment of mankind, but with the gloomy attitude that its abuse must be controlled. In short, they have confused heaven with hell.

In any event, over the past 30 years or so, it supposedly has become settled international law that each state or country "owns to the heavens," with no right of flight across any country except by its permission! In short, the present state of the international law of this subject is that it sounds better in Latin, at least if you do not understand Latin.

However, there are definite stirrings in the direction of "freeing" the upper strata of space. This would be analogous to freedom of the seas outside the territorial water zones of each state. The impetus towards this has been the development of the earth satellites. It is rather ridiculous to say that a satellite in orbit is trespassing on someone's territory, when that territory is moving under the satellite just as much as the satellite is moving over the territory. It makes no sense to think that an object which is directly above one is trespassing on the land. The question of whether or not it is directly above makes little or no difference insofar as reconnaissance is concerned (because of the great height), or insofar as its potentiality for doing harm is concerned.

Furthermore, if one really sticks to his story that he owns upward to an unlimited height, it is clear that he sometimes "owns" parts of the moon, the sun, and the stars. Now what happens if someone occupies part of the moon? Will he own it, or will a man in Detroit own it for a while, then a man in Moscow, and then a man in Peru?

In short, "ownership" of space to an unlimited height is pure Alice in Wonderland. We have begun to be accustomed to the idea of ownership of space commensurate with possession to a considerable extent in private law, and it is time we did the same in international law. It is time we got off our "high horse." ▲▲



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An important factor in the successful operation of J. K. Davison Bros.' ready mix plant at Etna, Pa., is the safe, high-speed unloading of the barges. For this job, Davison Bros. use a Clyde Whirley. With a 2½-yard clam shell bucket on a 110-foot boom, the Whirley empties a 250-ton barge in 40 minutes. The long boom and the Whirley's 360° swing allows progressive unloading into bins with a minimum of barge moving.

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Full-revolving, Clyde Whirleys have a reputation for dependable performance in the low-cost handling of all types of bulk, palleted or crated materials. Available in five standard self-propelled or stationary mounted models, with capacities up to 220,000 lbs. They require neither guy lines nor stiff legs . . . take a minimum of space.

Whatever your materials-handling problem, it will pay you to investigate the many advantages of Clyde Whirleys. Check with Clyde for profit-boosting equipment recommendations. There is no obligation.

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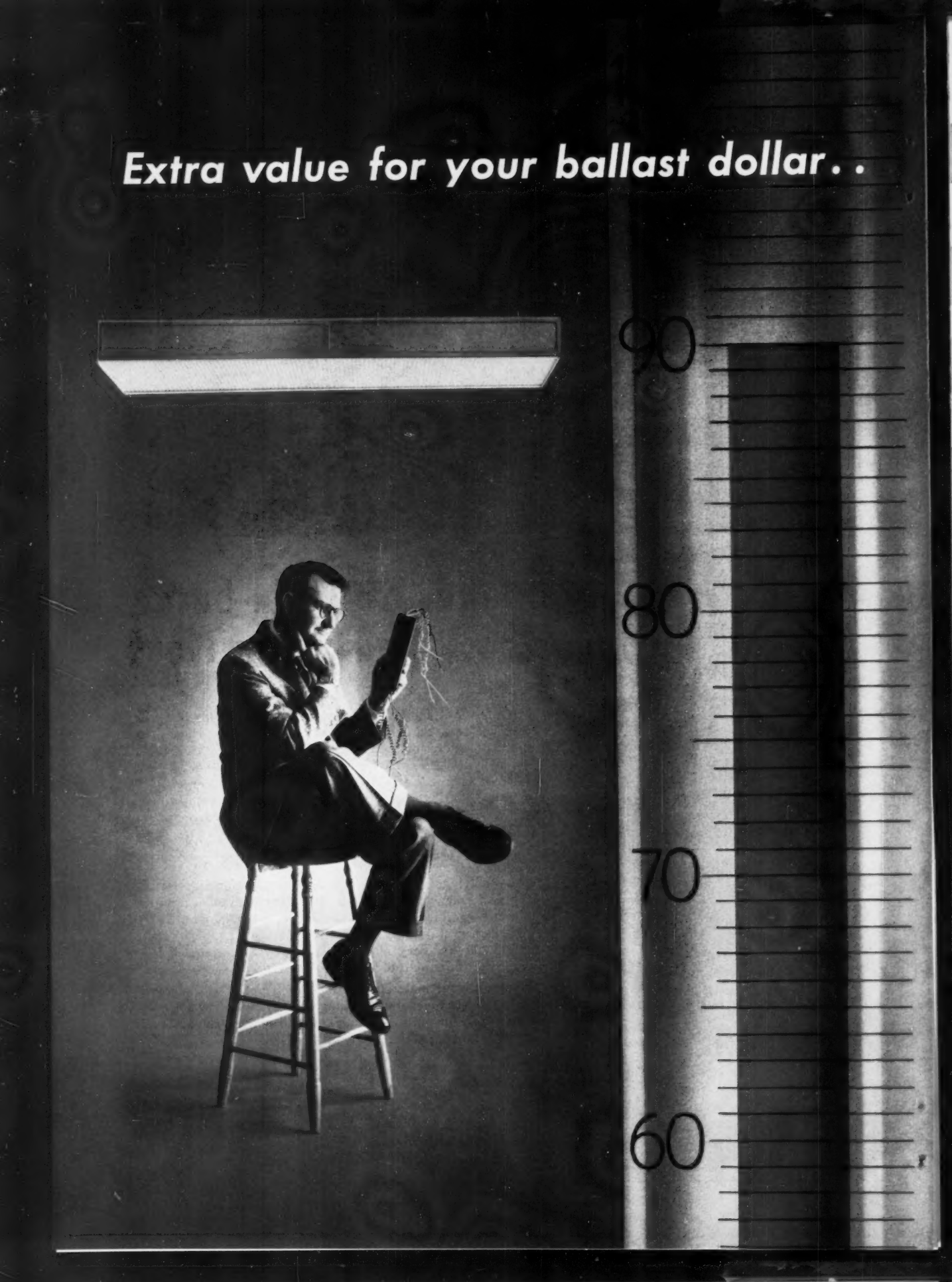
Extra value for your ballast dollar..



New G-E Ballast operates at less than 90C*

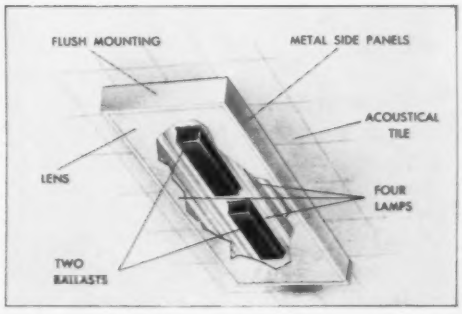
Announcing the new General Electric 6G1020 ballast for two 40 watt T12 rapid start lamps, the first in a line of ballasts that meet the demands of lighting progress.

Now, with no sacrifice in light output, sound rating, size or weight, General Electric offers you a ballast that, under normal ambient conditions, will operate below 90 C on the hot spot in any modern surface mounted totally enclosed four-lamp fixture.

There's a lot of talk in the lighting industry about the problem of ballast heating. The problem has existed since the first ballast was energized and will exist as long as there is progress in architectural, fixture and lamp design.

Actually, today's standard tests do not adequately cover ballast heating. Ballast heat tests originally developed as representative of earlier lighting installations do not give a true indication or measurement of how the ballast will operate in today's modern installations. The demand for higher working foot-candles and more efficient, more eye-appealing factories, offices and homes is being met through the introduction of higher output lamps, modern fixtures and the utilization of modern design concepts such as lower ceilings and sound-absorbing materials. True, the demands are being met, but this lighting progress also has generated new heat problems for the ballast industry to solve.

The most important step in solving this problem has been the development of a realistic new approach and new facilities for accurately determining ballast operating temperatures. General Electric ballasts are now tested in a new ballast-fixture heat test room. In this way,



Modern enclosed fixtures have increased light output but at the same time have contributed to today's ballast heating problem.

General Electric ballast heat measurements reflect actual operating conditions.

Each fluorescent lighting application is accepted as a separate challenge by General Electric engineers who know there is no one ballast that will act as a solution for all heating problems.

If fluorescent lighting progress is to continue, new low temperature ballasts must be developed. General Electric will continue to be a leader in ballast progress . . . another example of General Electric's OPERATION UP-TURN...extra value for your ballast dollar. Section 401-68, General Electric Company, Schenectady 5, N. Y.

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Buy now for extra values
GENERAL ELECTRIC

*at room ambient of 25 C

GENERAL ELECTRIC

Heard Around Headquarters

STAFF

THE NEW YORK State Society of Professional Engineers is short of funds, well supplied with complaints, and without the "office" of executive director right now. Although a resolution "dispensed with the office of executive director" at a prior convention, the office still is in the Grand Central Terminal Building. But the executive director, Harold H. Funk, is "dispensed." This, and other troubles, were discussed at the mid-May convention in New York City.

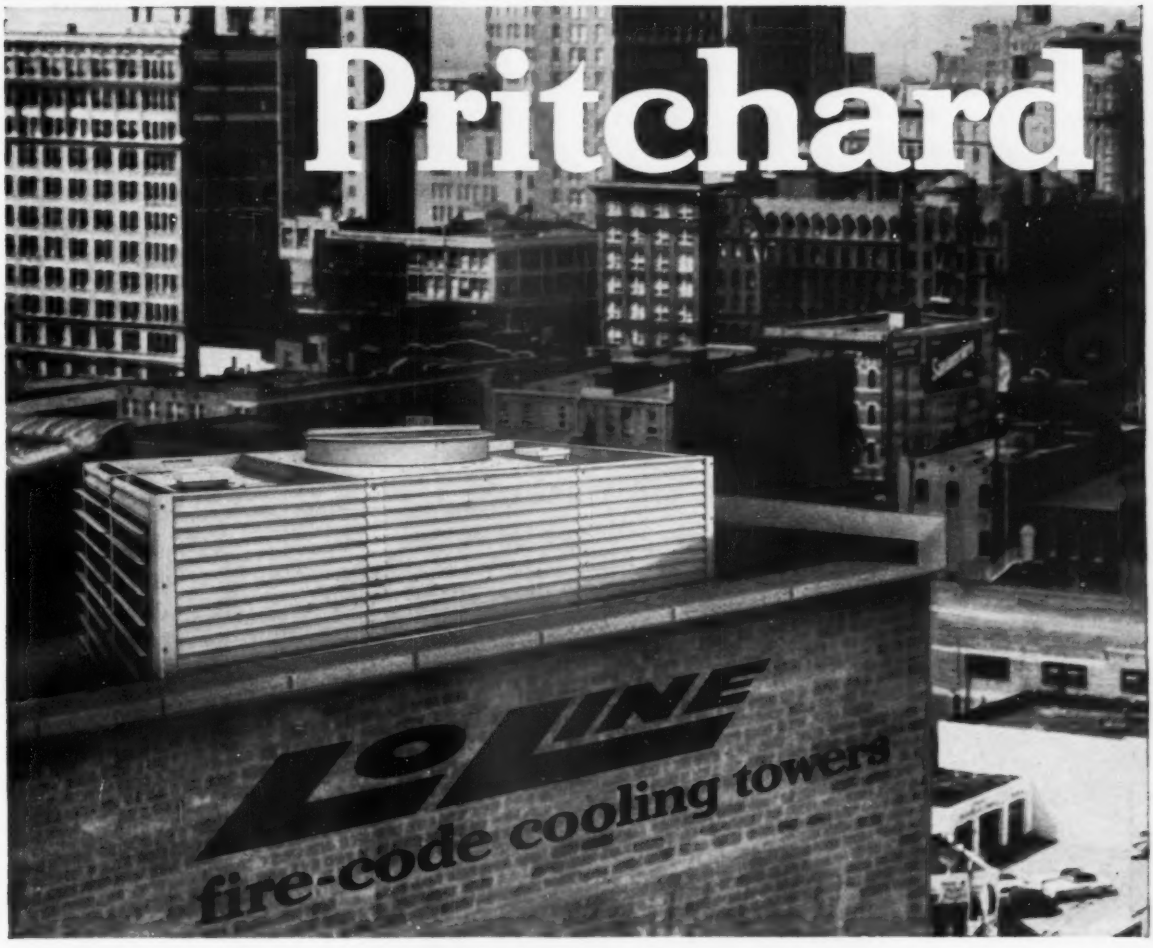
Financial troubles for NYSSPE began in 1952, when the organization spent thousands of dollars fighting corporate practice bills in the legislature. The finances never fully recovered. A deficit of approximately $4000 looms in the budget. This was given as the reason for dispensing with the office of executive director for six months (until Sept. 1).

President Franklin J. Johnson, in opening the board meeting, mentioned that the keynote of his administration was "Increased Chapter Activity on Professional Development." He concluded the report by noting: "In my report at the winter meeting, I stressed the importance of a strong headquarters organization if the work of our committees and our chapters is to be effective. When the board of directors, by a vote of 14 to 11, dispensed with the office of executive director for six months, I believe that it betrayed the expressed and implied wishes of the grass roots of our Society. In 1945, the membership amended the constitution and approved an increase in dues based on employing an executive director. Again in 1957 the membership further amended the constitution and bylaws to spell out more clearly the duties and responsibilities of the executive director . . .

"For the past 14 years there have been two schools of thought in the State Society concerning headquarters operations. One is to have an aggressive headquarters for leadership in professional progress, where information is maintained and disseminated to promote professional consciousness among engineers and the users of engineering services. The other is merely to have a job shop for clerical service. Six executive directors and dozens of clerical employees have been victims of this policy conflict. The result has been that the State Society has wasted thousands of dollars in frustrated efforts during that time."

Later, the "grass roots" spoke. Five chapters presented requests that the office of executive director be re-established. Nobody said who the director should be, just that there should be one. The matter was tabled, by a voice vote, and the "office" remained suspended.

The membership chairman (although the society reached its goal of 5000 members this year) suggested that internal strife might be hampering the organization. "The State Society has expended approximately $300,000 in the past five years. We feel that it can be stated without fear of contradiction that the State Society has not benefited the profession by that amount . . . Part of the reason we



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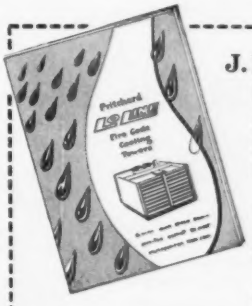
The new Pritchard LoLine cooling tower, companion to the Pritchard LoLine wood-framed tower, is specifically designed to conform to standard metropolitan fire codes. All structural members are steel. Louvers, casing, water distribution system and fan deck are asbestos cement. There simply is no combustible material exposed to the risk of fire.

But more than a fire-safe tower, this is a handsome cooling tower. Its low, sleek profile and uniform exterior treatment lift it out of the "necessary evil" class. It is well suited to installation where architectural considerations are important to the purchaser.

And it's a rugged tower. All steel parts are hot-dipped galvanized *after* fabrication for extra corrosion resistance. Heart quality California Redwood *only* is used for fill and drift eliminators to insure long, trouble-free life. Tough asbestos cement board exterior never needs painting. Tower maintenance is practically nil.

For full information on Pritchard LoLine Fire-Code Cooling Towers, mail coupon for Bulletin 5.2.902, which gives dimensions, mechanical details, specifications—the whole story. Or consult your nearby representative, whose name is listed in the Yellow Pages under "Towers."



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have not done enough to earn our keep in the last five years is the strife that continues to consume all our time and energy . . ."

The legislative committee reports that the Legislature is confused. "It is fairly apparent that because of wide differences of opinion, particularly within the Society, our Legislators are quite confused and find great difficulty in separating the majority opinion from the minority opinion. The result is that it will be difficult, even in the future, to get any bills, however beneficial, through the Legislature which materially affect that part of the Education Law relating to the practice of engineering."

Despite these "wide differences of opinion," NYSSPE reports showed some progress.

Membership—Goal of 5000 has been reached. New members in 1958 already total 418, and the 1957 increase in new members was more than 3000 percent over 1956, when the net gain in membership was only seven.

Legislation—Action this year in New York State leaves the status of laws governing the profession essentially unchanged. The only bill passed over the opposition of NYSSPE was to permit engineering students to gain work experience for credit towards a license examination at the same time they attend approved evening school engineering courses.

Another bill, which NYSSPE sponsored, died in committee. This was a proposal to provide a more definite interpretation relative to the control of professional engineering in both public and nonpublic areas. The legislative committee recommended that this bill be reintroduced next year – but as the committee pointed out, it will not be easy for the Society to get any bills passed.

Corporate practice, opposed by the Society, died its annual death.

Functional Sections—Forum meetings will be held, among functional sections, at the NYSSPE semiannual meeting in September at Utica. If the members like the idea of functional sections, the constitution will be revised at a later date to give charters to the sections. The board approved the principle of functional sections and referred the matter to the constitution and bylaws committee to prepare the necessary changes.

Recently, functional committees with appointive members have been considering the problems of specific membership groups.

The engineers in private practice committee reports recommended that "the major work in the fields of fees, contracts, specifications, codes, insurance . . . be left for the Association of Consulting Engineers, who are most vitally concerned with the problems." And the report suggested that the NYSSPE committee on private practice concentrate on formulating a policy on free engineering,

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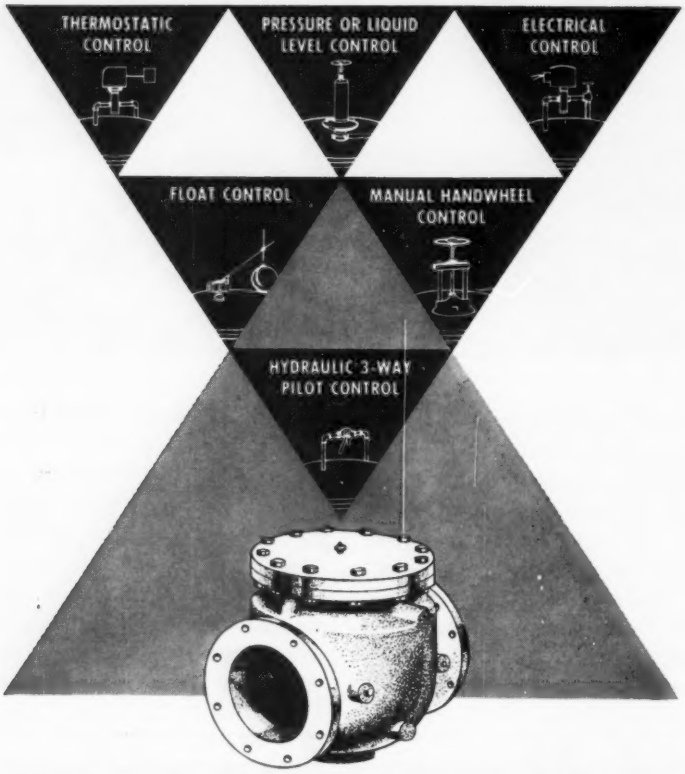

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Write for Bulletin W-8A

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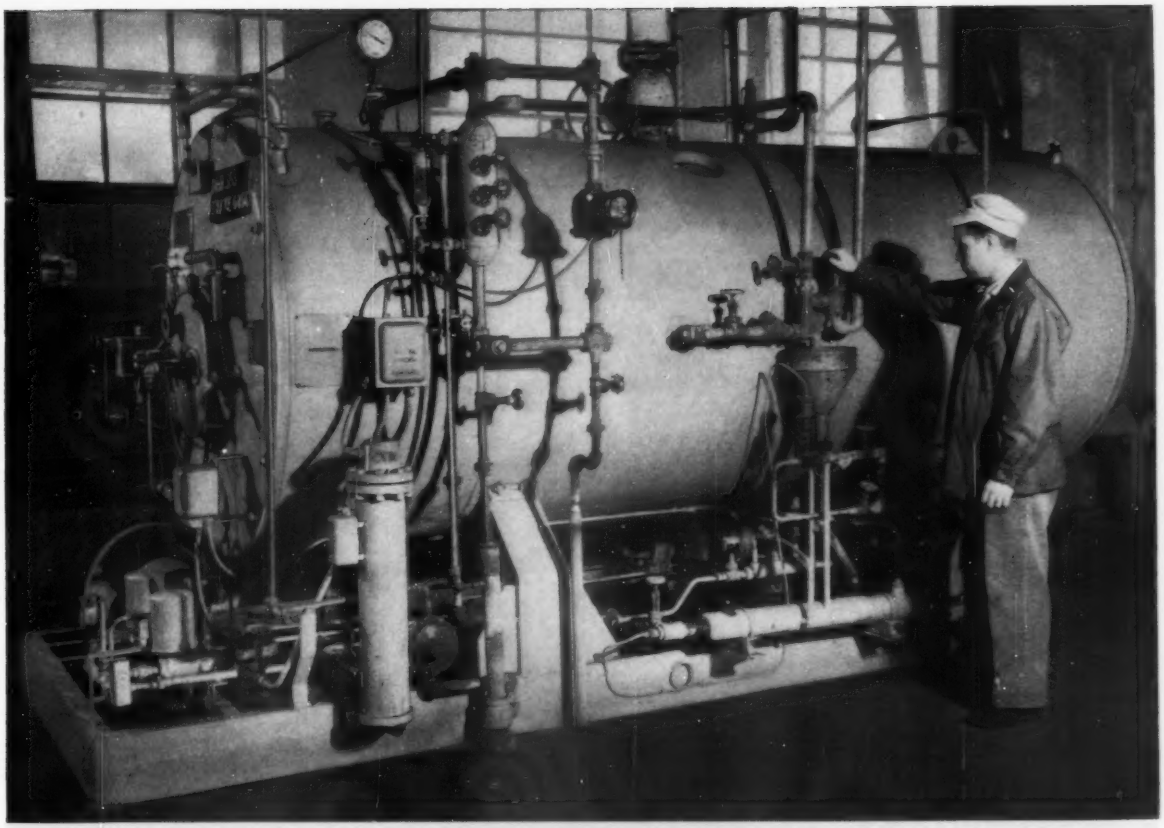

125 HP AMESTEAM GENERATOR Installation at Delaware and Hudson RR Diesel Shops at Binghamton, N.Y.

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"... we estimate $10,500 annual savings ... more than 44 percent return on our investment ... with the 125 HP AMESTEAM GENERATOR installation at our Binghamton diesel shops alone ..."

And that's only *one* of four AMESTEAM GENERATOR installations mentioned in a letter to us from Mr. P. O. Ferris, Chief Engineer of the Delaware and Hudson Railroad. Mr. Ferris goes on to say ...

"At the present time we have installed these generators at the following locations, at the estimated total annual savings of $29,899 shown:

LOCATION	H. P.	Estimated Annual Savings	Percent Return On Investment
Rouses Point	125	$ 8,350.00	33.2
Whitehall	200	6,841.00	22.3
Mechanicville	80	4,208.00	19.7
Binghamton	125	10,500.00	44.2
ESTIMATED TOTAL ANNUAL SAVINGS		$29,899.00	

What more can we add to this factual testimonial of satisfaction from the Delaware and Hudson Railroad? Only this: we have on file similar reports from hundreds of satisfied users of AMESTEAM GENERATORS. Among leading railroads alone, we number 40 satisfied customers ... using 194 of our economical, dependable "package type" boilers.

This all adds up to *your* assurance of savings and satisfaction with AMESTEAM GENERATORS.

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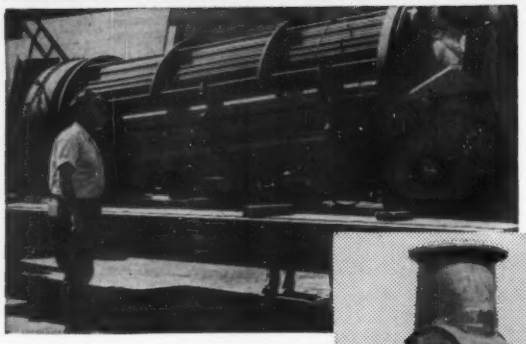
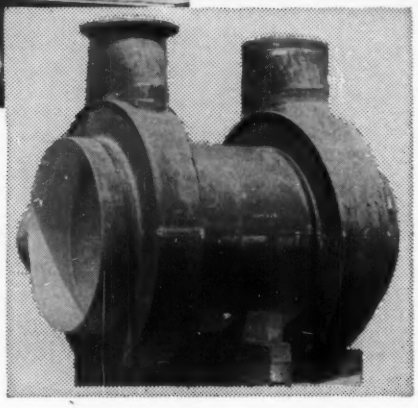


FOR TUBULAR EQUIPMENT



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part-time engineering work, advertising, and related problems.

As Leigh E. St. John, president-elect, pointed out, "The Association is doing a better job than we are on fees. We are not giving up any prerogatives—just working together. Let them carry the major load because it concerns only engineers in private practice."

Constitutional Amendments—The Society members voted against raising the maximum dues from $10 to $15 a year, with a $2 immediate increase. A suggestion that the board and membership meetings at future conventions be combined also was rejected. This would have involved some reorganization in order to decrease the size of the board.

Amendments were passed to allow annual conventions in the future to be held between May 1 and June 30 (so NYSSPE and NSPE can hold a joint annual convention next year).

Ethics—NYSSPE was requested, by the Assistant Commissioner of Education, to make recommendations on the criteria for unethical practice. The suggestions are to be considered by the Commissioner in revising the New York State law.

The ethical practices committee, in a report which will be sent to the Education Commissioner, stressed that the acts and omissions mentioned include, but not limit, what is unprofessional.

The suggestions are that unprofessional conduct in engineering or land surveying include:

¶ Offering to pay, paying, or accepting . . . any substantial gift . . . to influence the award of work

¶ Failing to exercise due regard for the safety . . . of the public . . . affected by professional work for which he is responsible

¶ Associating himself with projects known to him to be not legitimate

¶ In professional matters, expressing an opinion or giving testimony not founded on adequate knowledge while serving as a witness . . .

¶ Willfully permitting gross disregard by contractors of plans or

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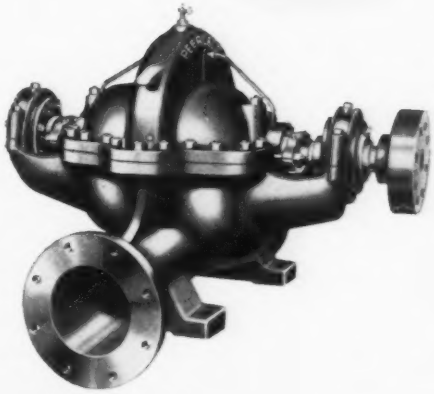

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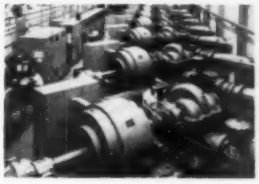

WRITE FOR BULLETIN NO. B-1300

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Be sure to check the new "A" Line models against your specifications for any of a broad range of industrial applications—principally where steam, water, and oil pressures must be indicated.

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specifications when professional supervision of the work is under his control

¶ Accepting a substantial gift, bribe, commission, or other consideration from contractors or other parties dealing with his clients or employer in connection with work on which he has professional responsibility

¶ Having a financial interest, without the knowledge of his client or employer, in the bids of contractors for work on which he has professional responsibility

¶ Willfully completing, signing, or sealing plans or specifications that are not in conformance with requirements for public health, welfare, or safety

¶ Being willfully untruthful in professional reports, statements, or testimony

Also considered by the committee, but not included in the suggestions, was listing it as unethical for an engineer or surveyor to do work for which he is not qualified.

This could have presented problems for such persons as engineers working on missile development. Some phases of this involve several branches of engineering. Yet a civil engineer working on a structural problem of a combined civil-mechanical project possibly could be accused of being unethical in doing "work for which he is not qualified."

Committee members pointed out that this list can be amended or lengthened in the future as the need arises.

Michigan Consultants Meeting

In conjunction with the ASME semiannual meeting in Detroit June 17, a joint panel discussion has been scheduled by the ASME and the Consulting Engineers Association of Michigan. Taking part in the program will be: Frederick Von Voigtlander, representing the Michigan Society of Professional Engineers, speaking on "Relationship Between the Consulting Engineer and His Registered and Non-registered Employees;" John R.

FOUR STORIES ABOUT DUNHAM-BUSH

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A 75 Ton Heat-X Package Chiller, efficiently assisted by a rugged Brunner Compressor, supplies chilled water to the air conditioning system. 130 Dunham-Bush CRV Remote Air Conditioning units provide quiet, year 'round air conditioning of the building. 20 Dunham-Bush Recessed Convectors satisfy the heating demands.

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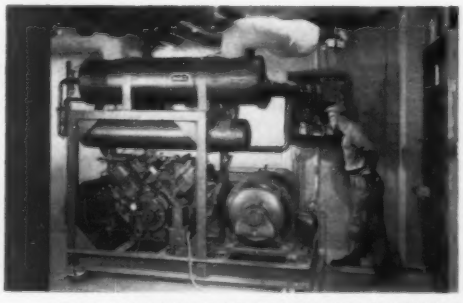

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The cost of Reznor unit heaters is comparable to or lower than that of other types of equipment of equal heating capacity. And with Reznor, this is the total cost. You don't have to add the costs of extensive piping and valves or duct work, and of radiators or registers. Reznor gas unit heaters produce and distribute heat at the point of need. To install them involves only suspension, venting and utility connections. So installation costs are much lower than those of central heating systems. Lower equipment cost . . . lower installation cost . . . two reasons why Reznor gas unit heaters can offer substantial savings on heating systems for so many commercial and industrial buildings.

SAVE SPACE

Reznor gas unit heaters are installed up at the ceiling, completely out of the way. When you design for a store or factory, you don't have to allot a single square foot of valuable space for heating equipment . . . and you don't have to keep floor or wall areas clear for radiators or registers.

INSURE FLEXIBILITY

When you specify Reznor gas unit heaters you don't have to choose between a heating plant which is over-sized and over-priced for current requirements and one which may not be adequate for future needs. With Reznor unit heating, when that new wing is added, additional heaters are installed. It's as simple as that. And in the case of internal remodeling, it's very easy and inexpensive to relocate the existing heaters.

ONLY REZNOR GAS UNIT HEATERS OFFER ALL THESE ADVANTAGES

- Clean, modern design, back as well as front . . . all controls and connections inside the cabinet.
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- No costly frills and gadgets . . . features which are needed only to meet special situations always separately listed and priced.
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There is no "equivalent" for Reznor gas unit heaters.

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Snell, representing the Consulting Engineers Association of Michigan, speaking on "Relationship Between the Consultant and His Client;" and John G. Hoad, representing ASME, speaking on "Relationship of the Consultant and the Technical Societies."

AIA-EJC Committee Named

AIA-EJC joint committee has been named, and plans are under way for its first meeting. Engineers on the committee are: Charles H. Topping, ASCE; Henry A. Naylor Jr., ASME; Charles I. Maust, AIEE; John E. Haines, ASHAE; and Warner Howe, NSPE.

AIA representatives will be Roy Larson and William Eshback, both of Philadelphia, and Arch Winter, Mobile, Ala.

New GHQ for Engineers

In its flight from the wholesale hat district to the more respectable neighborhood of the United Nations, the new engineering headquarters building fund has reached the halfway point in its drive for $10 million.

So far, $3,097,200 has been raised from industry and the Founder Societies. An additional $2 million is listed as available in United Engineering Trustees (joint corporate agency of the five Founder Societies) funds and as estimated income from sale of the present headquarters building.

The Founders Societies have been asked to contribute according to membership. Their respective shares are: AIEE, $900,000; ASME, $800,000; ASCE, $800,000; AIME, $500,000; and AIChE $300,000.

No decision has been reached by the committee about possible centralized services, such as typing and mailing and the like.

CE Association in N.J.

New Jersey now has an association of consulting engineers, complete with a slate of officers, and already it's in the constitution and bylaws stage. On May 10, a group of 18

10 stories up at 8 below

Erection of USS AmBridge Steel Joists continued through Pittsburgh's coldest winter

This picture was made on one of the coldest days in Pittsburgh last winter. It shows steel joists that will support the roof of Duquesne University's new 10-story steel-frame Hall of Law and Business building overlooking downtown Pittsburgh.

While most outside construction work in the Pittsburgh area came to a dead stop during the cold snap, *the placing of steel joists* went on as usual.

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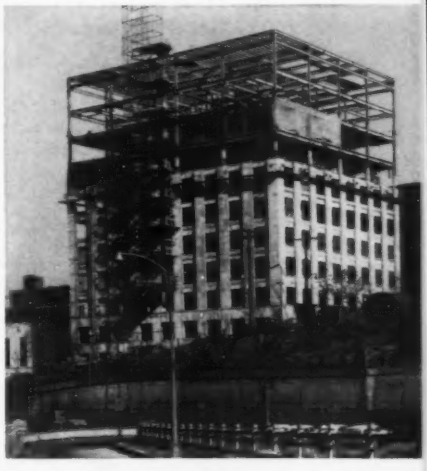
In addition to their use in the 10-story classroom building, AmBridge* Steel Joists were also used to support the roof and stage floor of the Auditorium Annex. American Bridge also fabricated the steel frame for these structures. In all, 1,131 tons of steelwork was supplied for this job.

If you would like to know more about the time- and money-saving advantages of USS AmBridge Steel Joists, ask for a free copy of our 36-page catalog.



Duquesne University Law and Business Building, Pittsburgh, Pa.
Designed by William York Cocken, Architect, Pittsburgh, Pa. ▶

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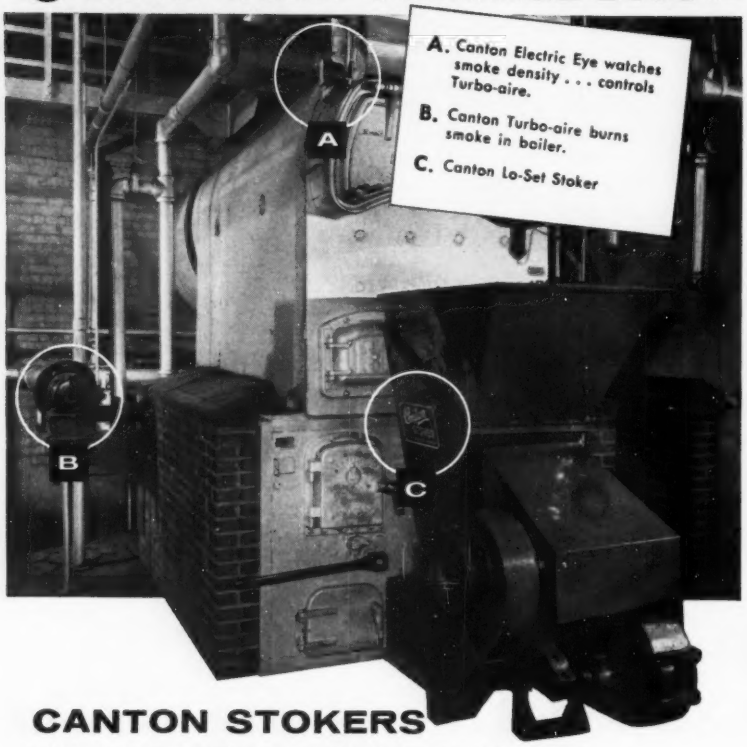
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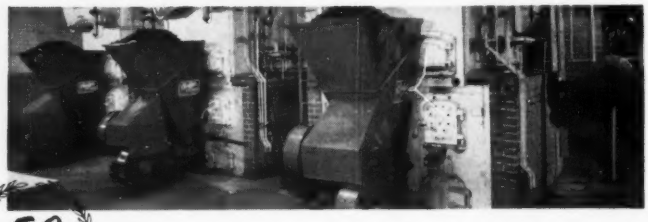

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consulting engineers organized the as-yet unnamed association, and the group hopes to hold its second meeting late this month.

Officers elected are Col. Harry Terry (who called the meeting), of Trenton, president; John Teutter, Camden, vice president; and Edward J. Adamec of Fair Lawn, secretary-treasurer. It was suggested that later, the office of secretary-treasurer could be split.

Representing the Consulting Engineers Council at the meeting was William Knecht, of the CEC membership committee.

New CEC Officers Named

Charles C. Pate, head of Pate Engineering Company, Tulsa, has been elected president of CEC for the 1958-9 term. One of CEC's original founders, Pate has been first vice president for the past two-year term.

New first vice president is L. K. Crawford, partner of Crawford, Murphy and Tilly, Springfield, Illinois. Named second vice president is Ralph M. Westcott of Holliday and Westcott, Los Angeles. Hueston M. Smith, of Smith, Hanlon, Zurheide and Levy, St. Louis, is the new secretary, and B. M. Dornblatt, of B. M. Dornblatt and Associates, will be treasurer.

Pate replaces Edward J. Wolff, Chicago consulting engineer, who remains on the CEC executive committee as immediate past president.

Michigan CEA Slate

Named officers of the Consulting Engineers Association of Michigan are: president, John R. Snell, of Lansing; vice president, John B. Harju, of Ferndale; secretary-treasurer, Wesley Bintz of Lansing; director, M. W. Benjamin of Detroit.

The association also voted to join the CEC, electing John Snell delegate and Albert Migdal of Detroit alternate delegate.

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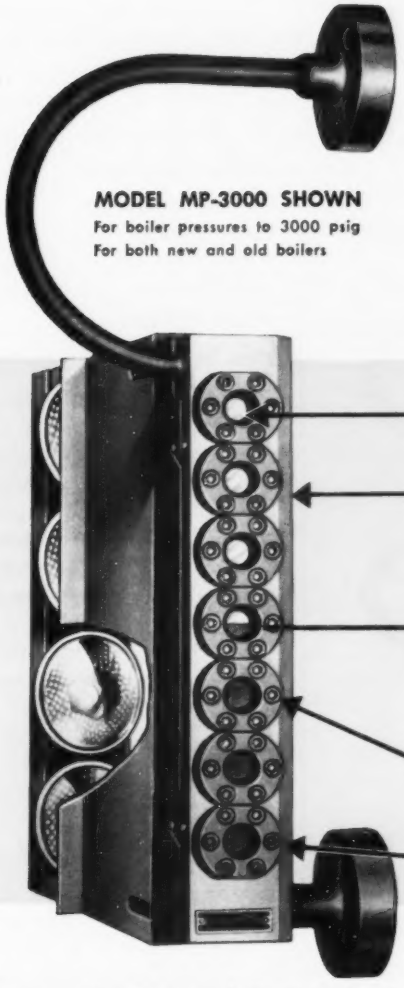

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eration Engineers and the American Society of Heating and Air-Conditioning Engineers, ASME has appointed a committee to look into the possibility of greater cooperation and increased liaison with the participants.

The ASRE membership will vote on the merger at a meeting in Minneapolis June 23 to 25. ASHAE members are not scheduled to vote until later this year.

Indiana Organization Formed

Indiana consultants have formed the Consulting Engineers of Indiana. Group secretary is Joseph Szalay, 4216 College Avenue, Indianapolis, Indiana.

Joint Architect-Engineer Contracts

The AIA-ASCE-NSPE joint contract, under consideration for many moons, is nearing publication. AIA has approved, and ASCE and NSPE have approved "in principle," the architect-engineer form contract. However, the engineer-architect contract has not received AIA approval yet.

AIA spokesmen said they hope to have the approved contract available for distribution at the annual AIA convention in Cleveland in July. ▲▲

Article Reprints

For free copies of reprints listed below, write on company letterhead to Reader Service Dept., CONSULTING ENGINEER 217 Wayne St., St. Joseph, Mich.

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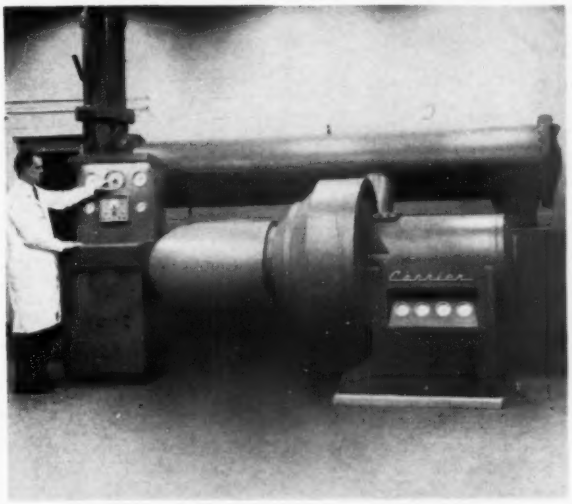

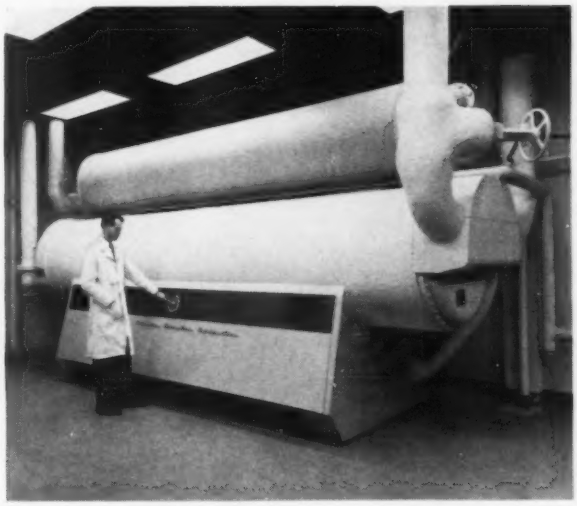

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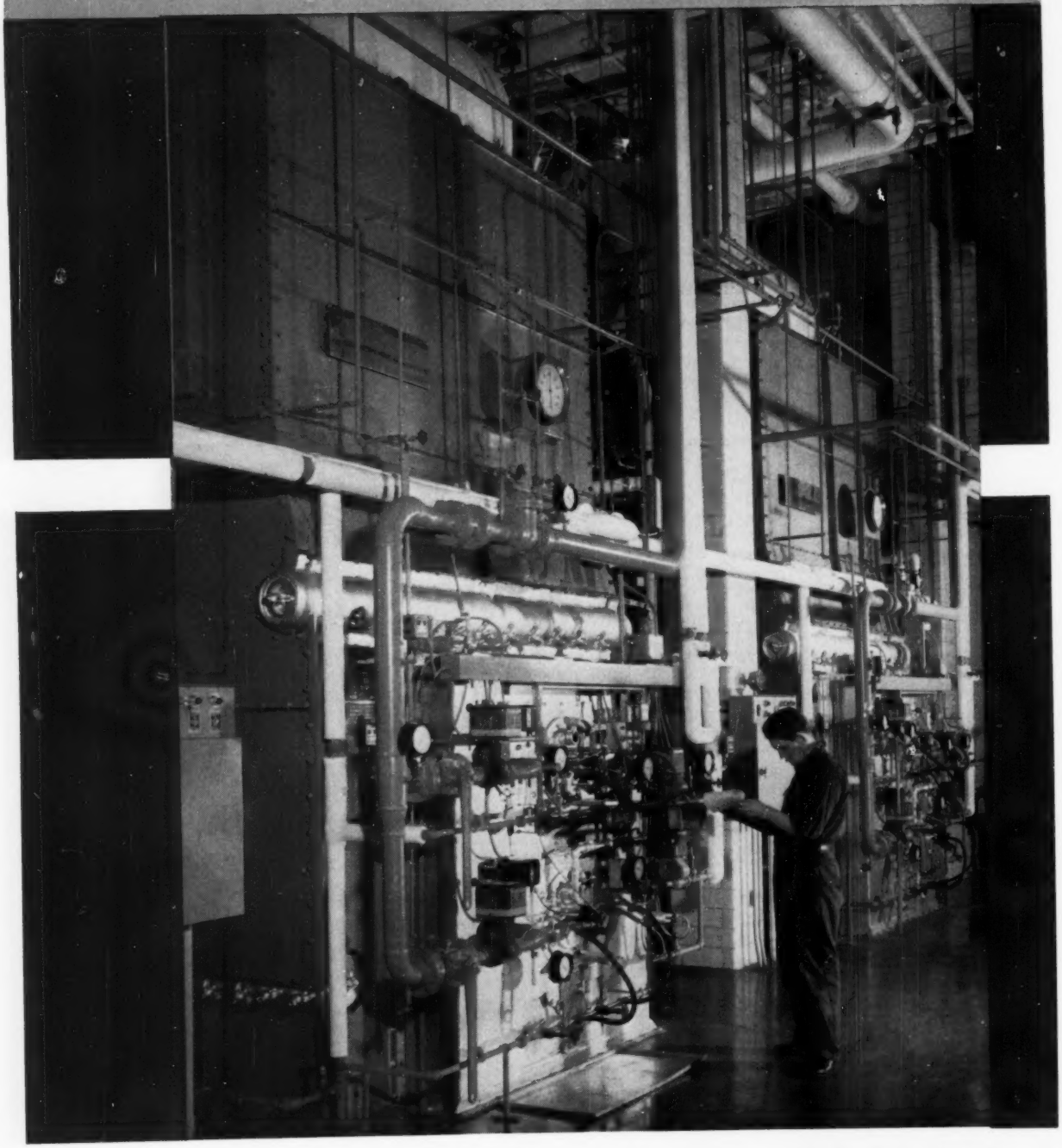

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Atoms in Action

JOHN F. LEE
Distinguished Professor and Graduate Administrator
North Carolina State College

Science Consultants

THIS SPACE and atomic age has had profound effects on the engineering profession in general and, in particular, on the practice of consulting engineering. Coincident with the development of atomic energy, a new class of consultants from the field of atomic science emerged to compete with engineering consultants in many activities, and especially in atomic power. These new consultants do not pretend to be engineers. One can claim that they actually perform engineering services, but this claim poses a legal question which no one yet has raised seriously. In many instances, however, these science consultants have been employed by engineering consultants and industrial firms for services outside the scope of activities of most consulting engineers.

The space age already has begun to usher in another group of science consultants whose activities range from chemical kinetics to astronautics. It is too early to decide to what extent these spatial consultants will compete with engineers, and to what extent engineers will be dependent upon them for the solution of difficult problems. One need only read the daily newspapers to see that the scientist has left the laboratory and donned a business suit to direct, both technically and in a sense politically, the great projects of this age.

Constructive Thinking Needed

It would be an idle and sour gesture to criticize the usurpation of engineering prerogatives by scientists if usurpation it is. Science consultants clearly render either a service the engineer is incapable of performing or one to which he is indifferent. Any attempt to harass the performance of the services by scientists by invoking literal interpretations of professional registration laws would only be futile for the engineering profession.

Yet, if something is not done, it is entirely possible that in years to come the profession of engineering could be emasculated to the point where it would be little better than a highly skilled white-collar trade. The fault lies not in the existence of competition but in the derelict failure to prepare engineers for such competition – for a dynamic profession which must change rapidly with the times to meet new and unusual demands. Engineers must recognize that the art in engineering has given way to a more scientific approach. The static tools of an art are poor implements to meet the challenges of the fast-widening scope of modern engineering.

Evolution in Engineering Training

If the practice of engineering is yielding ground to the science consultants, it is obvious that the proper object of criticism is the professional training of engineers. If this criticism is to be constructive, we should examine thoroughly the evolution of engineering education to determine probable causes for the present state of affairs.

Although formal civilian engineering education in this country began in private universities, the land-grant colleges have made the deepest imprint on the engineering profession in terms of numbers. The *raison de'etre* of the land-grant college origi-

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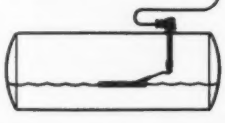

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nally was to prepare technicians in the areas of agriculture and mechanical arts, with reasonable opportunities to benefit from the social and cultural amenities usually associated with institutions of higher learning. The primary motive was practical training to perform specific functions efficiently and skillfully. Although the curriculum of an early land-grant college resembles that of a modern trade school, it was appropriate to the relatively primitive industrial society of its day.

Influence of Changes

The important consideration in the land-grant college movement was the preoccupation with training men to perform specific functions. Therefore, a slow feedback mechanism alerted the colleges to changing needs in the occupations for which the students were being trained. When occupational changes are relatively slow such a system works fairly well. Parenthetically, one wonders why such industrially primitive countries as India and Indonesia have not taken a leaf from this book instead of sending their students to our advanced institutions.

Altogether different is the situation in modern engineering where changes have become so rapid that the feedback mechanism is either too slow in its response – or it fails entirely. Furthermore, the signal is confused because the changes are far more fundamental than merely the development of new skills at a more rapid pace.

Abilities Challenged

A serious question arises as to the ability of today's engineering graduate to meet the problems facing the engineering profession during his career. This question disturbs engineering educators who now must make predictions for the future, and decide the type of education that will best serve their students' future needs. There is no escape from this responsibility because to do nothing, or not enough, is certain to be wrong. Many engineering educators still predict future needs of the profession in terms of the current needs of the personnel recruiters who visit their campuses.

Experimentation in Curricula

Engineering educators who now are concerned with the need to revitalize professional education have been forced either to minimize or abandon the professional courses in favor of a more adequate education in the basic sciences and mathematics. This fact in addition to the requirement for more general education and the strait jacket of the four-year curriculum has reduced engineering education to something far less than professional education. As a result many industries find it necessary to offer more training to engineering graduates either in

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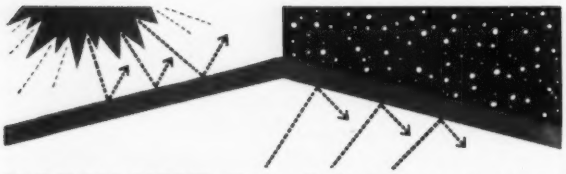

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company programs or in cooperative programs with neighboring educational institutions.

Curricula with highly specialized objectives also are not the answer. The newest of these attempts, nuclear engineering, has had many unfortunate results according to many reports from industry. The scientific basis for work in the area of nuclear engineering is so exacting that many of the elements of engineering education have to be abandoned. The result is a dual personality as a quasi-scientist and quasi-engineer who cannot do an effective job as either a scientist or engineer. More fortunate results have been obtained when the graduate of a regular engineering curriculum makes further studies in nuclear science or when a physicist does further work in engineering.

Engineers and engineering educators now agree that before a student presents himself as a candidate for admission to a professional school of engineering, he should have completed a four-year curriculum in which a rigorous treatment of the basic sciences and an ample general education are offered. Much of the work done in our present graduate schools should be moved into the professional schools of engineering without the emphasis on research which now characterizes these programs. Those who desire to enter research could achieve this objective by post-graduate training as is done in the medical profession.

The future of the engineering profession does not rest with the educators alone. There is a definite need for engineers to take a long-range view of their profession and to cooperate with the educators in formulating programs to meet future needs. In this matter of cooperation the engineering profession could profit by observing their professional brothers in the medical and legal professions.

Financial Problems

Many of the demands made on engineering education cannot be met by even the most far-sighted educators without a drastic change in the measure of financial support given to engineering schools. The profession has done a good job of recruiting engineering students, but it has distinctly failed in promoting a program of public education on the financial needs of schools of engineering. There is an imperative need to revise upward the salaries of engineering professors not only to meet the requirements of revitalized programs but to prevent deterioration of existing standards.

If any engineer has doubts about the state of engineering education in the atomic and space age, he need only examine them in terms of a son he might be sending to engineering school next fall. Would this son receive the education required for a career in engineering 15 years from now? ▲▲

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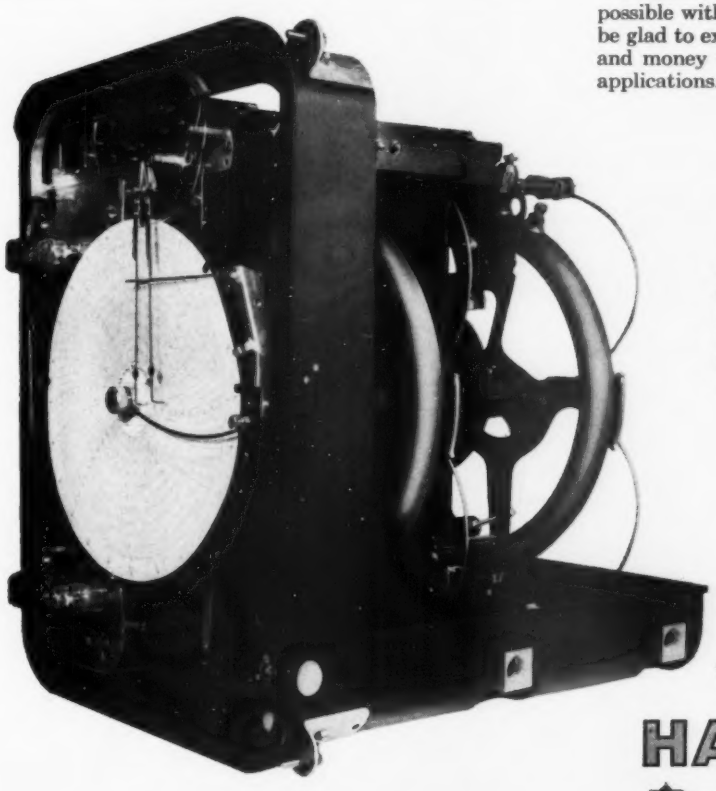
- with a SLIDE WIRE TRANSMITTER—the Ring Balance Meter may be used as a transducer with data logging systems or with the Hagan PowrLog recorder. Slide wires in series may be used to totalize and/or integrate a large number of flows.

These are only a few of the many special applications possible with the Ring Balance. A Hagan engineer will be glad to explain how Ring Balance can save you time and money in a wide variety of metering and control applications.



Hagan Dual Ring Balance meter with case removed. The two rings, housed in a single meter case, may be used to record and integrate two different flows, control their ratio, or calculate their sum or difference.

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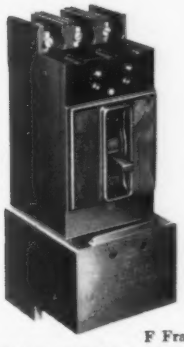

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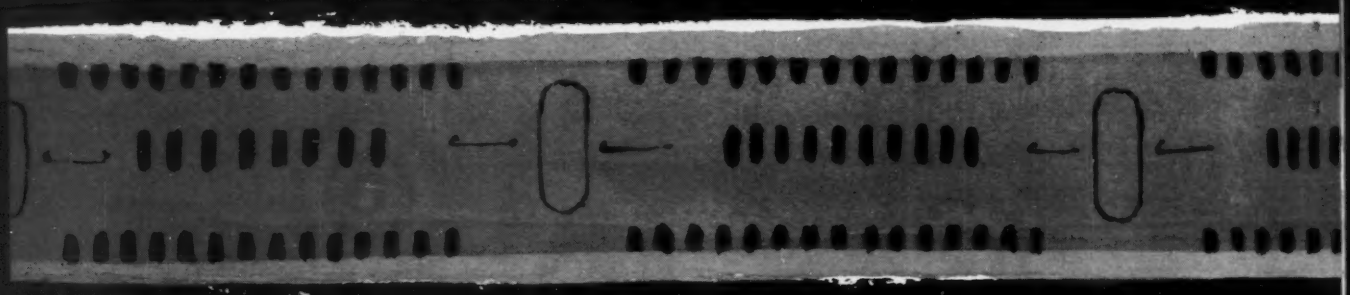

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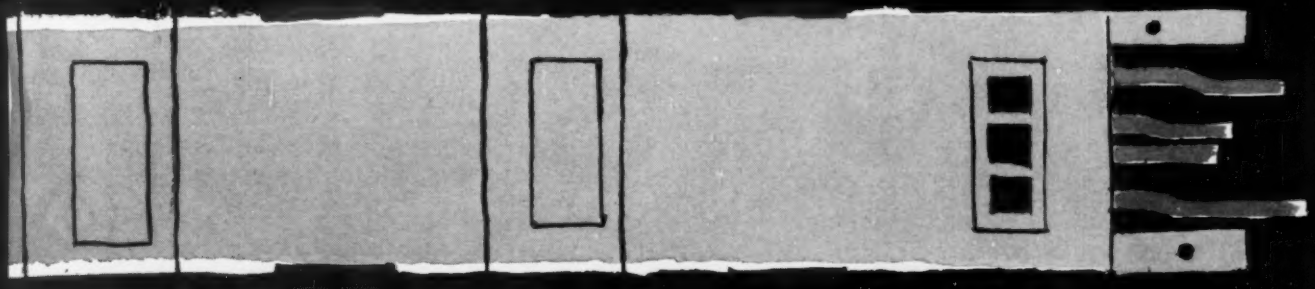

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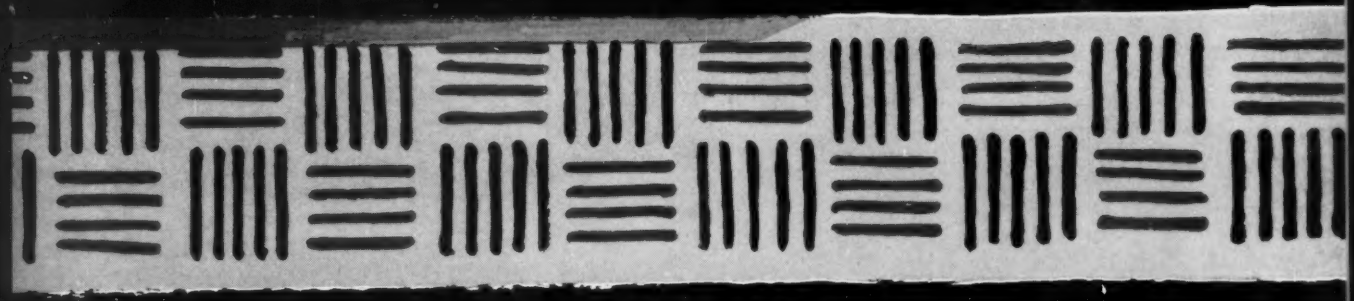

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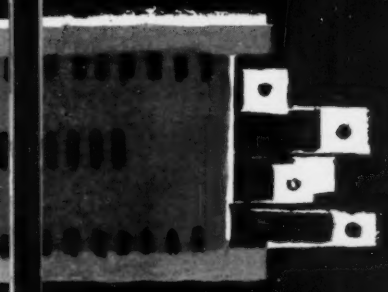

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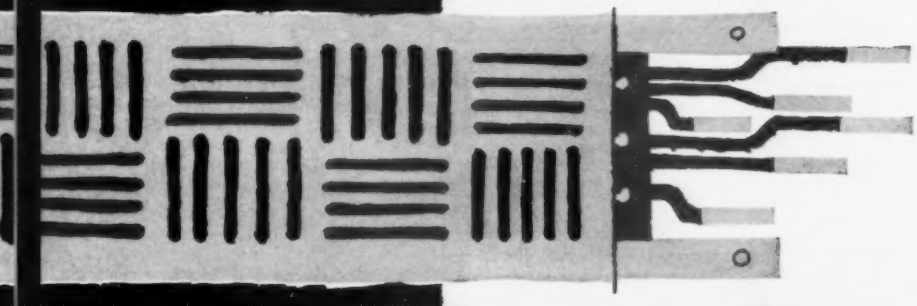

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Report from the West Coast

RALPH S. TORGERSON
Consulting Engineer Correspondent

ETHICS was the main topic of a recent meeting of the Consulting Engineers Association of Oregon. The open-forum discussion covered new developments, particularly in government work, where consultants must be constantly alert to professional encroachments, and education of government departments and officials.

CE exclusive

The engineers, with Holly Cornell, chairman of the Association's Practices Committee presiding, considered several important items:

¶ Can contingent fees be paid as shares in a corporation or as part of a company? Most members agreed that if the canons of ethics of the engineering profession were not violated, there would be no objection. The extent of the fee was not considered to be relevant as long as no competition between engineers existed.

¶ How should feasibility surveys be handled? Most members felt that no feasibility survey should be made without proper remuneration. Preferably, feasibility studies should be a separate item not connected with preliminary and final plans, and the cost to the client should be determined from the regular fee schedule.

¶ What is a proposal? Majority opinion indicated that a proposal consists only of a statement of facilities available. Only after selection has been made should a fee be discussed with a client.

Problems Warrant Study

The question of fees for feasibility studies and preliminary engineering work sometimes is involved. An engineering firm in the State of Washington doing work for sewer districts points out that when the sewer district comes into being it does not have any funds, and preliminary engineering services have to be supplied on a contingency basis. This is not an isolated case, for the situation is prevalent throughout the area.

Almost every consulting engineer at some time is confronted with the question whether he will take a speculative job or, similarly, one where there is a time lag before final payment can be obtained. As the consultant becomes more established, he is less inclined to take such projects. Generally, only less-experienced engineers accept speculative work. But even experienced engineers sometimes prepare preliminary studies for promotional or bond-selling purposes which are knowingly speculative.

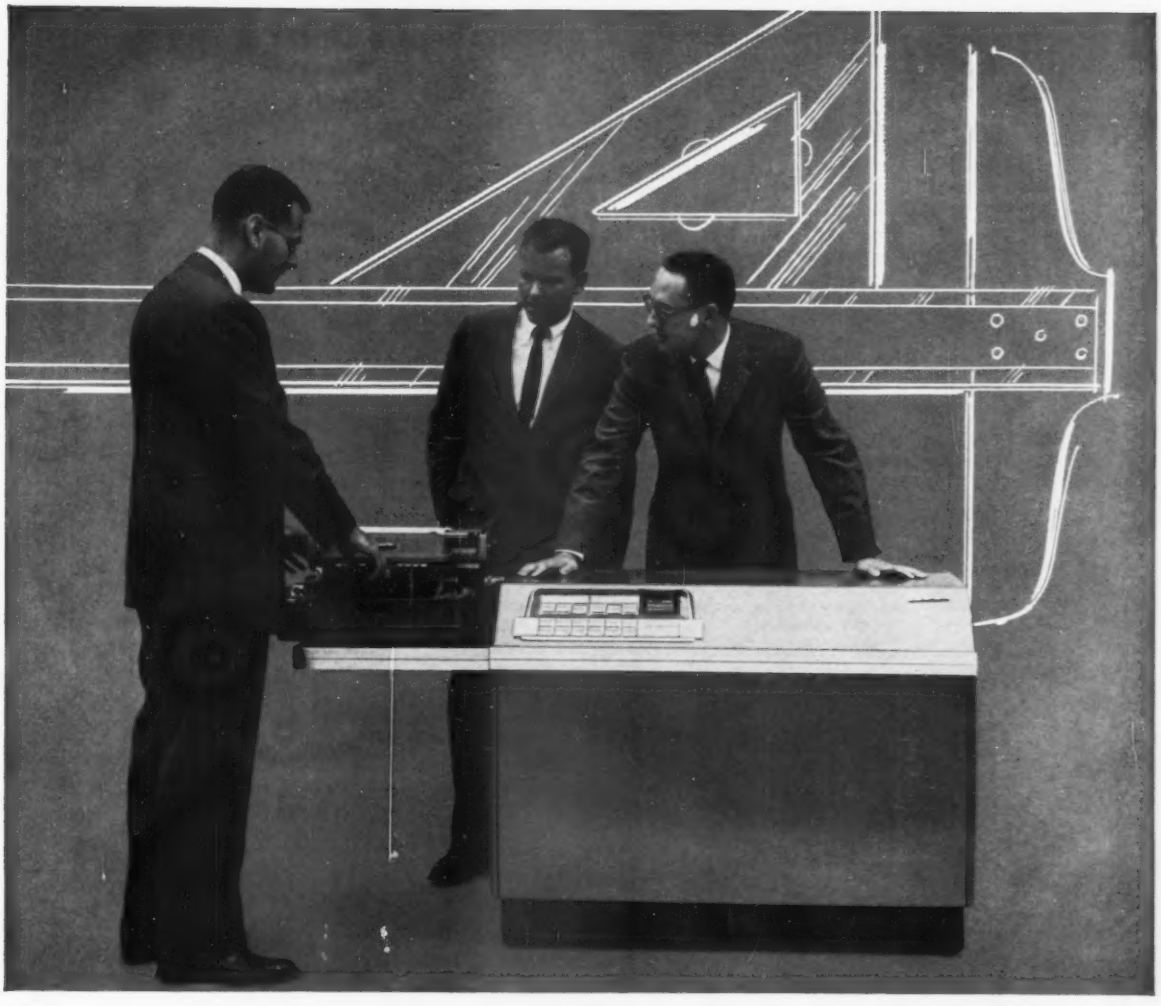
It is a gamble for the young engineer, who may lack sufficient capital to meet every contingency in carrying the job to completion, but often it is the means of establishing himself in the profession.

In most structural work, the architect holds the prime contract and the engineer is a subcontractor. The engineer with long experience knows the professional background and financial responsibility of the architects he deals with, but an engineer just entering consultant work must get this knowledge by inquiry before accepting new contracts. Some large firms do not subcontract from architects, but only accept prime contracts with the owner.

Typical Policies

David L. Narver, Jr., of Holmes & Narver, Inc., Los Angeles, outlined his firm's practices for its large amount of government and industrial work.

"We do not take contracts unless money is available to pay our fee, except when the work is of a business development character. If it is of a sales nature, we are prepared to write off the venture, if



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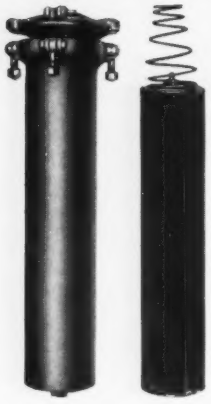

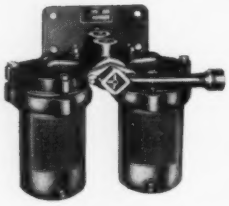

Fig. 1555BF Duplex Filter uses factory packaged laminated fiber disc filtering elements. Each filter comprising duplex operates independently or in parallel. Wide range of sizes.

Fig. 1576 Bag-Type Pressure Filters feature inexpensive, completely disposable filter cartridges. For filtering fuel oil, lubricating oil and wide variety of fluids.

AT LEFT: Fig. 1555-4L Filter and laminated disc cartridge. High flow rate; low pressure drop. Excellent micronic efficiency. Cartridges interchangeable with all other Nugent Bag or Depth Type cartridges.

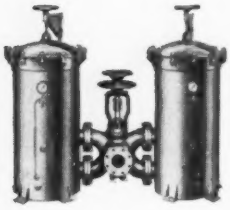

Fig. 1554AN-4L7 Duplex Strainers provide the advantage of uninterrupted flow, without by-passing, while cleaning the strainer baskets. Each strainer comprising duplex uses 7 strainer baskets Fig. 1554A-4L.

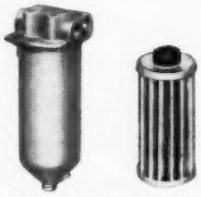

Fig. 1490AM-0 star-shaped extended area strainers offer increased free screen area over round basket type.

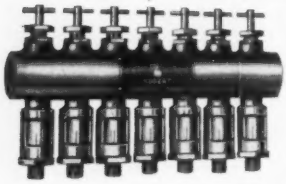

Fig. 1503F Multiple Pressure Oilers are available with from 2 to 24 feeds.

Fig. 524 Sight Feed Valves with removable glass. ¼" to ¾" IPS.

Fig. 1575 Pressure Sight Flow Lubricator. Single units or multiples to 15.

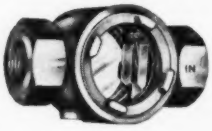

Fig. 1366E Sight Flow Fittings for indicating flow of liquid in a pipe line. Available in brass, cast iron, steel or stainless steel.

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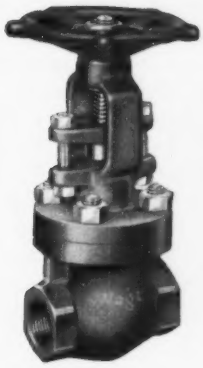
unsuccessful, as an overhead item and govern expenses accordingly.

"Nearly all our contracts with public bodies contain a clause stating the source of funds, all of which must be available whether or not construction funds are. In the case of private companies, we do not take on the job unless the client has a good reputation. Our biggest risk of not being compensated is eliminated by not subcontracting from architects. Our contracts are always prime contracts with the owner."

Harold P. King, of King, Benioff & Associates, Los Angeles, expressed another view of this question. "In most cases we make a nominal charge to cover at least our costs for any preliminary work of a promotional nature and, in most instances, have been able to collect it. On government work, such as Navy projects, there is no free work expected. However, for our regular clients we often prepare preliminary designs on some projects for which we may not be paid. This is a service we generally render our regular clients, whereas we would not be inclined to do it for a one-time client."

Dudley Deane, of Dudley Deane & Associates, San Francisco, voiced these pertinent comments. "Before a consulting engineer enters into an agreement for services on any project, he should judge, from information available, whether or not the project is likely to be completed. To do this, he must know the owner's arrangements for financing, the leasing market, and any other conditions which might affect the feasibility of the project. If there is a chance the project may be abandoned after preliminary services and estimates, his agreement should provide for this contingency. One way to do this is with a contract that provides the engineer shall be compensated at a multiple of his cost (in our case, 2½ times technical payroll) for schematic or preliminary services. If firm commitments are obtained after the preliminary work is done, indicating the project will



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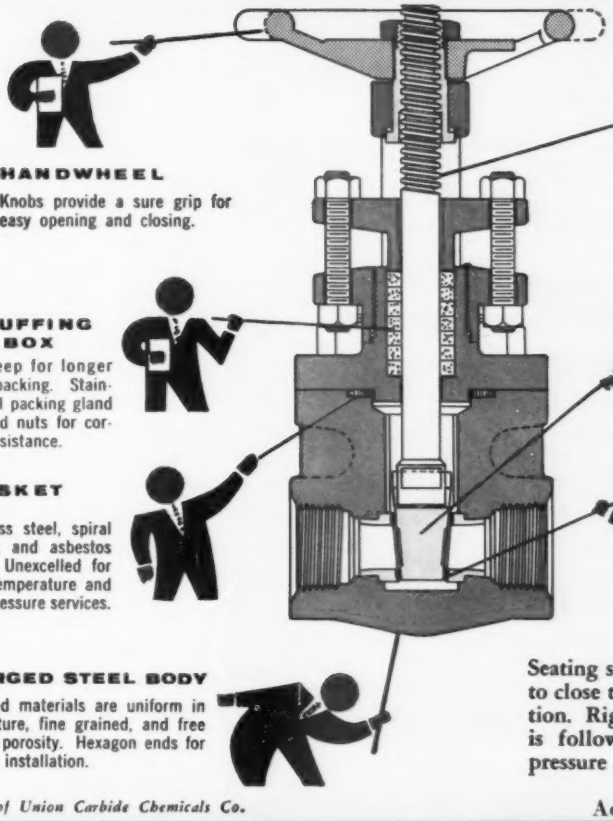

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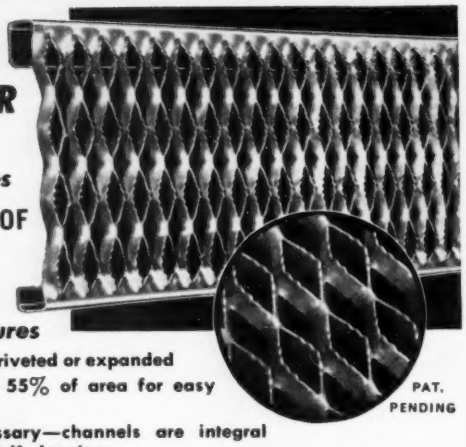

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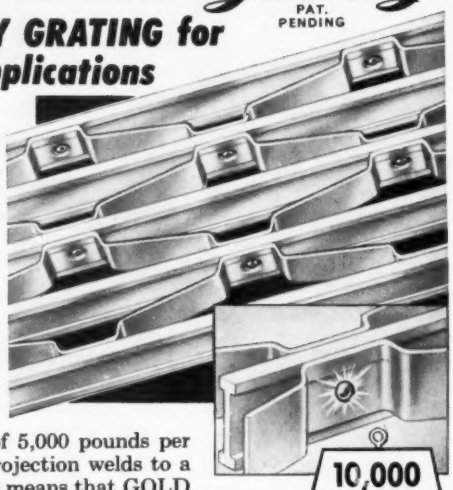

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be completed, this portion of the fee may be applied to a total percentage or a lump-sum fee.

"Even if the engineer thinks the project will be finished, all contracts should contain a clause regarding abandonment or suspension which protects him. Compensation for services performed to the time of abandonment may be based either on a multiple of the engineer's costs to that date, or upon a proportion of the estimated total fee. Unfortunately, consultants who subcontract with architects seldom have control of the architect's agreement with the owners and therefore are limited in abandonment protection by the owner-architect contract. In such cases, the engineer should confer with the architect as early as possible, and perhaps guide him in his contractual agreement. On the other hand, if the architect has made satisfactory provisions, which is usual, the architect-engineer contract can conform to these provisions."

These approaches to the problem were suggested by William T. Wright, of Kistner, Wright and Wright, Los Angeles. "The contracts should provide that the preliminary studies will be performed for a fixed fee or that payments will be based on a percentage of the estimated construction cost (preferably 25 percent of the total estimated fee). The contract also should have a cancellation clause stipulating that the engineer will be paid for preliminary work even if the project is not completed.

"Another method would be to base the preliminary work on the engineer's actual production costs, plus a percentage for overhead and profit, such as 2¼-2½ times the cost of engineering and drafting work.

"Our experience shows government agencies and many other clients want to hold design costs to a set amount so that their obligations are determined before work is started. We feel a stipulated amount in the contract is the most acceptable way to do this. Certain-

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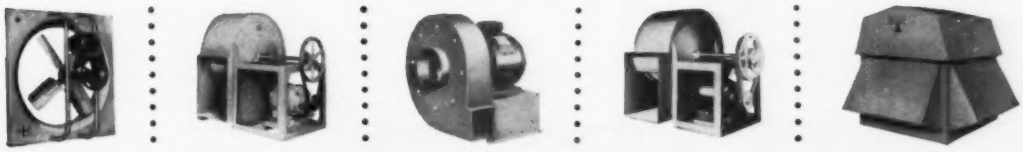

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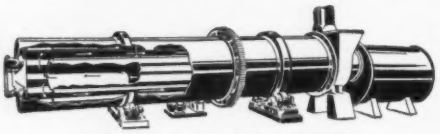
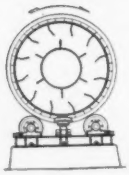
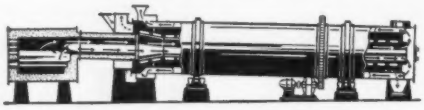


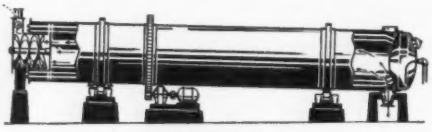
Semi-Direct Heat, Double-Shell Dryer, ideal for coal drying.



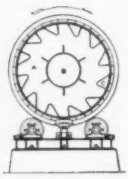
Cross section of Semi-Direct Heat, Double-Shell Dryer showing lifting flights on inner and outer shells.



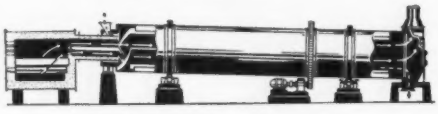
Indirect-Heat, Double Shell Dryer for kaolin, chalk, china clay, etc.



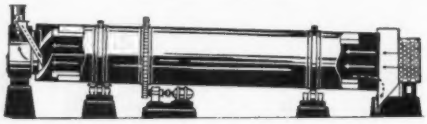
Rotary Steam-tube Dryer designed for raw chemicals.



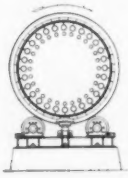
Cross section of Indirect Heat Dryer. "A" is the completely isolated space in which the material is dried. "B" is the inner hot gas passage. "C" represents the V-ducts for the gas return.



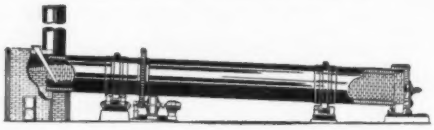
Single-Shell, Direct-Heat Dryer Parallel or Counter-Flow for sticky organic or inorganic materials.



Hot-Air Dryer for drying inorganic salts and similar materials.

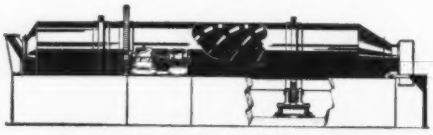


Cross section view of Steam Tube Dryer.



Rotary Kiln for continuous calcining, roasting or oxidizing.

Cross section of Single-Shell, Direct Heat Dryer.



Rotary Cooler for continuous cooling of hot materials after drying or calcining.

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ly, every effort should be made to prevent any client, government or private, from expecting an engineer to provide free engineering for the preliminary phase of any project. If the engineer's costs are fully explained to the owner in the beginning, he probably will not have any difficulty getting paid for the preliminary work."

H. W. Waller, of Hubbell and Waller Engineering Corporation, Seattle, reporting on his experiences with the contingency fee problem, said, "We have had only one such case. There we took the job on a contingency fee basis, offering to do the preliminary engineering to set up information required for a bond issue. If the bond issue passed, we were to be awarded an engineering contract, but if the bond issue failed to pass, we would mark it off.

"A lot of our work is for small towns in Alaska. If the bond issue does not pass, they have no funds available to cover engineering fees. It is a gamble for the engineer to go into a situation like this."

Frank E. Alderman, of Alderman and Swift, South Pasadena points out the problem is difficult to handle. "Aside from possible financial loss if the project does not materialize, the engineer must be particularly careful that his judgment is not colored by a desire to see the project go forward. As a general policy, we refuse to accept projects on a contingency basis, particularly where funds could be made available for the preliminary work.

"However, where because of special knowledge of a problem it is desirable that we be employed, and when there is no way for the client to reimburse us, occasionally we furnish such preliminary services without assurance of reimbursement. In all such cases, these have been for former clients who were unable to set up funds until the preliminary report was finished. I do not think an engineer ever should solicit such work

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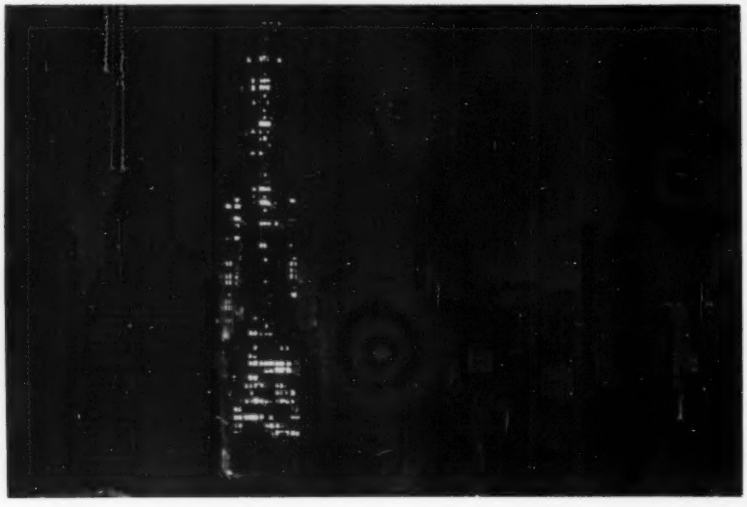

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from new clients in order to gain an advantage in obtaining the design work on a project."

Joint Ventures

It is common practice for contractors to set up joint ventures on large projects, pooling equipment, manpower, and financial resources to mutual advantage. This practice is increasing among consulting engineers for much the same reasons. The specialized abilities and experience of two or more engineering firms can mean adequate service on the demands of big jobs. The recent announcement of the Holmes and Narver, Inc.-James M. Montgomery joint venture to supply the engineering for the new San Diego sewerage system is a good example.

This same idea may be used by engineers on a smaller project, though it may not involve a contractural arrangement like a joint venture. Pooling manpower may help level off workloads on draftsmen and engineers. There are periods between projects when one engineering firm may not be very busy while another firm needs additional help to meet a deadline. Such exchanges of manpower have meant more steady employment and a reduction in costs. There is also less of a gamble in securing experienced personnel.

Professional Centers

Engineers are taking offices in buildings with other engineers, much as doctors have offices in medical-arts buildings. Specially built structures, housing several engineering firms, are designed to provide well-lighted air-conditioned quarters, often on the outskirts of cities but convenient to transportation and highways.

CEAO Nominates New Slate

The Consulting Engineers Association of Oregon nominating committee has named these candidates for office: president, Holly A. Cornell, of Cornell, Howland, Hayes and Merryfield, Corvallis; vice presi-

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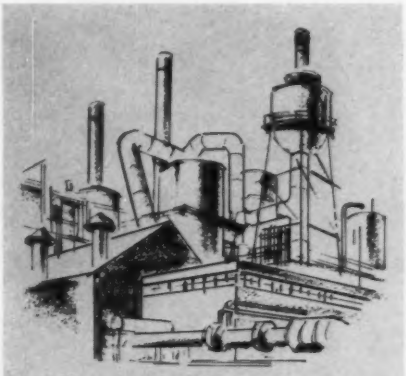

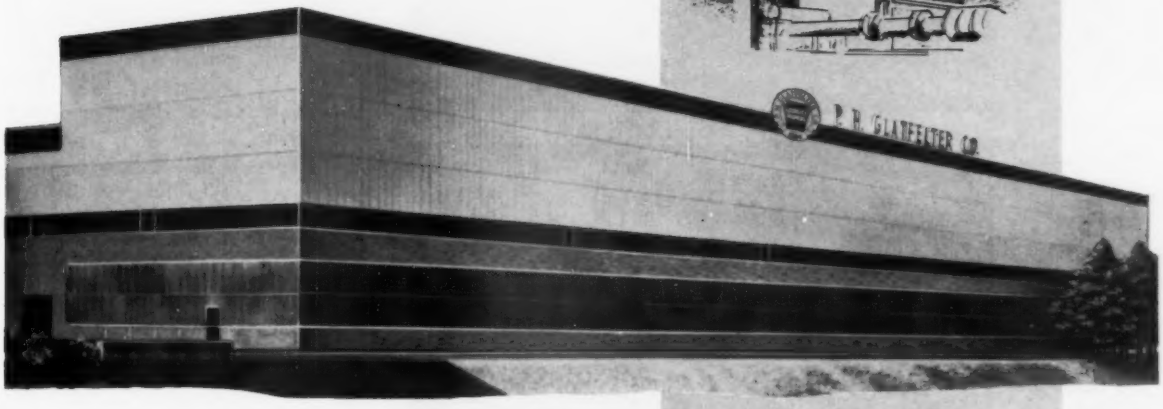

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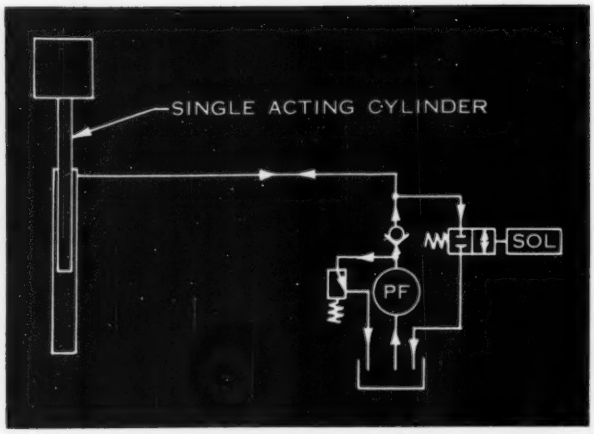
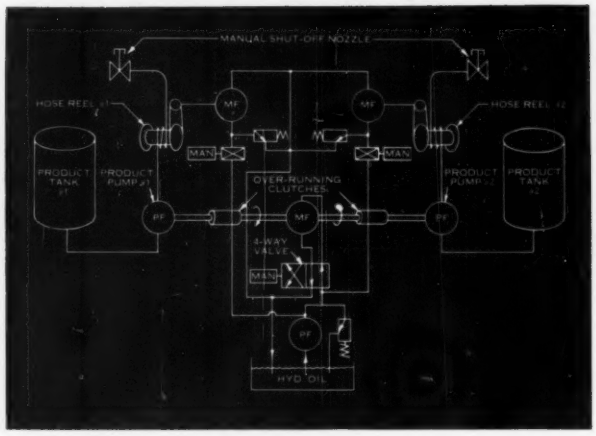
SIMPLE CIRCUIT



COMPLEX CIRCUIT



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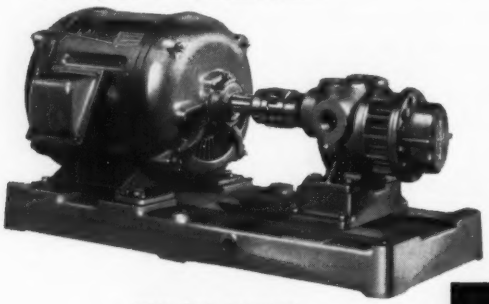

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dent, Guy H. Taylor, of Moffatt, Nichol and Taylor, Portland; secretary, Thomas L. Johnston, of Stoyanov and Johnston, Portland; treasurer, W. Bruce Morrison, Portland; metropolitan director, R. S. Rose, of Cooper and Rose and Associates, Portland; and director-at-large, Lloyd Clark, of Clark and Groff, Salem.

California Activities

The CEAC board of directors ratified an amendment to the bylaws providing that all members of a partnership or officers of a corporation who meet membership requirements should be members of the Association. Before, the bylaws read that such men "shall" be members of the Association. The directors also voted to limit members from any firm or corporation to four.

The directors appointed Mark Falk (chairman), G. M. Simonson, and Lyle E. Patton as liaison between the Association and the State Department of Public Health, Hospital Division. The committee will confer with the engineering consultant of the Hospital Division and review any proposed rule changes as embodied in Title 17, California Administrative Code.

Several CEAC members notified executive secretary Pecos Calahan they had received an invitation from the CAA Procurement Officer in Los Angeles to submit a sealed bid for professional services in connection with a proposed CAA facility near Petaluma. The matter was immediately taken up with the CAA Washington office.

The CAA Procurement Division chief replied: "Concerning our Fourth Regional Office invitation to bid for engineering services at San Francisco, we have wired our regional office to obtain these services by contract negotiation.

"We have further directed all of our Field Headquarters Contracting Officers to process requirements for architectural and engineering services through negotiation rather than on a competitive basis." ▲▲

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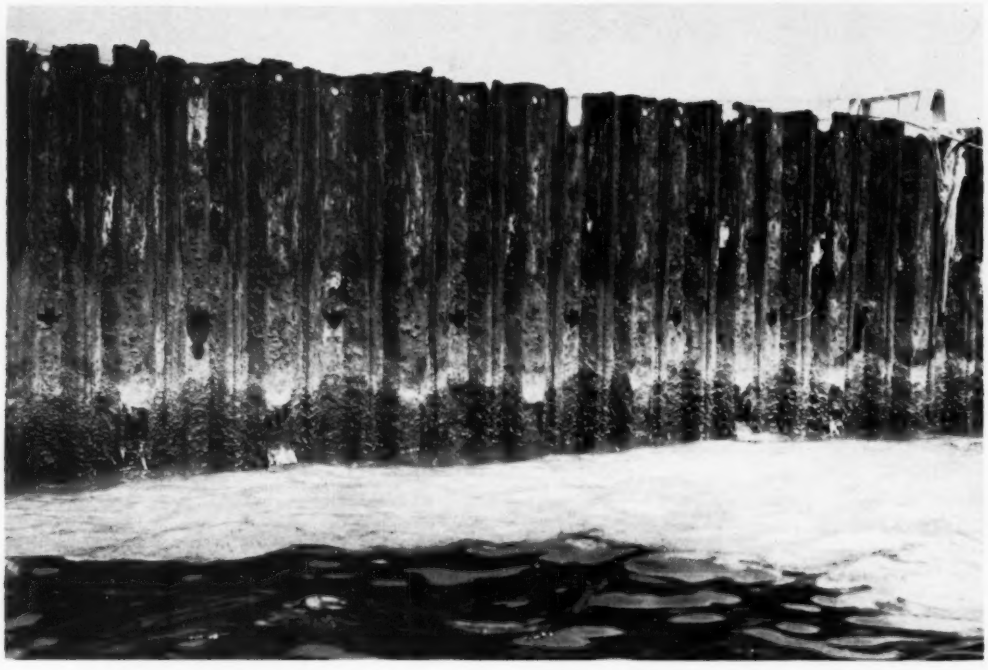


Corrosion and perforation of sheet steel pilings in Midway submarine basin after 10 years' service.

Steel Piling in Sea Water

BENTON C. LATTIN, Ebasco Services Incorporated

Benton C. Lattin, electrical engineer, Ebasco Services Incorporated, graduated from Harvard University in 1943 with a B. S. in Engineering Sciences. From 1946 to 1951 he was an engineer with the Westchester Division of the Consolidated Edison Company of New York where he spent much of his time on various corrosion problems. In 1951 he joined Ebasco Services Incorporated and since has devoted all of his time to corrosion control and grounding problems. Places Lattin has visited on corrosion control projects for Ebasco include Hawaii, Guam, Kwajalein, Midway, Bermuda, Venezuela, Liberia, and the Philippines as well as about twenty states in the U. S. He holds memberships in the National Association of Corrosion Engineers and the American Institute of Electrical Engineers, and he is a registered professional engineer in the State of New York.

IT IS DIFFICULT today to find a harbor in which pile driving operations are not being carried on, for piles are being used increasingly as foundations for piers, wharves, drilling platforms, and moorings. Since these structures often cost several million dollars, it is very important that their foundations be as permanent as the structures themselves. Only if careful attention is paid to design, installation, and maintenance can long life be assured.

Most piling used today is of wood, steel, or concrete reinforced with steel. Each of these foundation construction materials has advantages, and it seems all three types will continue to be used.

Wood Piles

Wood is moderate in cost, easily worked, and readily available. However, wooden piles and pier decks have a tendency to become fire hazards

because they soak up oil and grease. Decreasing pollution brought about by more rigid control of municipal and industrial sewage is expected to increase the attack on wood piles by marine organisms which hitherto have been unable to thrive in some polluted harbors. The most dangerous marine borers from the standpoint of destruction of commonly used wood in the United States are Limnoria and Teredos.

Limnoria are small crustaceans about ⅛-in. long that burrow into the surface of the wood. The effect of Limnoria attack is most evident in the tidal zone where they produce an hour-glass shape to wooden piling. Untreated piles can be destroyed by Limnoria in a year in heavily infested waters.

Teredos (shipworms) are mollusks of several species that superficially are worm-like in form. In the early stages of life they are swimming organisms. After finding suitable lodgment in wood, they develop into a new form and burrow themselves deeply. The Teredo lives upon the wood borings which it produces and upon organic matter extracted from the sea water. One unfortunate aspect of Teredo attack is that the entrance holes are never very large and the interior of a pile may be completely honeycombed while the surface shows only slight perforations.

The most commonly used chemical for treating timber piles to prevent marine organism attack is coal tar creosote, which is fully effective only when it is applied by a pressure process that forces the solution deep into the cells of the wood.

The severity of marine borer attack depends upon a number of conditions such as water temperature, salinity, pollution, and current. On the New England coast and on the North Pacific coast a wooden pile, if well treated, often can have a service life of 15 or 20 years, whereas on the South Atlantic coast and in the Gulf of Mexico a treated pile can be expected to have an average life of only 10 years. There are several tropical hardwoods such as greenheart, turpentine, and totara that have shown unusual resistance to marine borer attack.

Steel Piles

Within the last decade there has been an increase in the use of steel piling as underwater foundations. Formerly structures of this sort were built of wood or stone. Steel with its high strength, weldability, and resistance to fire is in many ways an ideal material for the construction of marine facilities. Modern pier designs often call for steel H piles well over 100-ft long capable of supporting loads of 50 tons per pile. Furthermore, a service life of 40 years or more is possible.

In order that the engineer can intelligently prepare a steel pile foundation design, he must consider first the problem of maintaining the structure after it is built. The effects of corrosion on the steel pile and the methods of treatment necessary to control this corrosion must be studied.

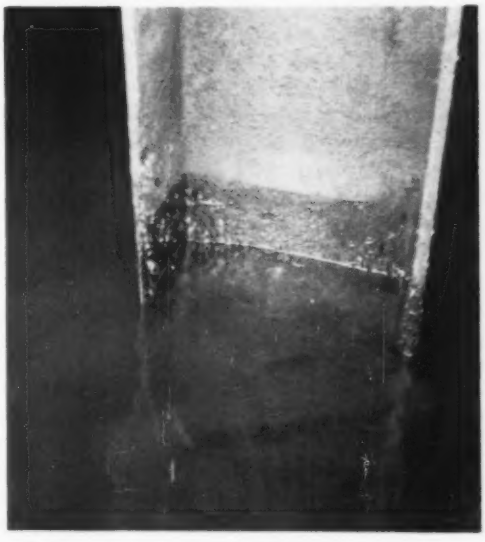
Corrosion of Steel in Sea Water

The effects of sea water corrosion on steel ships are controlled by regular painting and replacement of badly corroded hull plates, and more recently through the use of cathodic protection. On many commercial vessels an annual drydocking and inspection is required by law. Piling, however, is much more difficult to inspect, since most of the structure is either buried or submerged.

Another complication arises from the fact that most modern piers have a heavy reinforced concrete deck. Consequently, wholesale piling replacement usually is impractical without replacement of the entire structure. It is to be expected that some bulkheads and piers, designed for a 40-year life, actually will fail by corrosion after only a little over 10 years of service.

It has been our experience that failures of the type illustrated can occur almost anywhere in the world on piers where control of corrosion was not considered either during the design phase or as a part of normal maintenance. Once corrosion damage has occurred, there is little that can be done except for making above water and underwater repairs by welding of steel reinforcement plates at locations where the piling is heavily corroded (a costly and tedious process) or installing a concrete cap or jacket.

Some pier owners who have had unfortunate and costly experiences become so wary of steel



Thinned left flange of this H piling shows 35 percent eaten away after nine years' exposure.

Splash zone of bulkhead and sheet steel piling on Pacific island has been completely corroded away.

piling by virtue of unexpectedly high corrosion rates occurring either in the splash zone or just below low tide level that they shift to wooden or reinforced concrete piles. At one West Coast location I personally witnessed the replacement of a steel pier by a wooden one because of excessive corrosion damage to the unprotected steel piles.

Underwater Corrosion

With all the accumulated experience of the last hundred years with iron or steel ships, it would appear that sufficient data would be available to predict accurately the behavior of steel piles in sea water. However, most of the test work that has been carried out during the last several decades in the attempt to measure the normal corrosion rate for steel in sea water at various locations involves the use of small steel test specimens. These test specimens are installed at various underwater levels, and weight measurements and thickness determinations are made at the end of the test. The corrosion rates for these steel specimens generally fall within the range from about one mil per year to over seven mils per year.

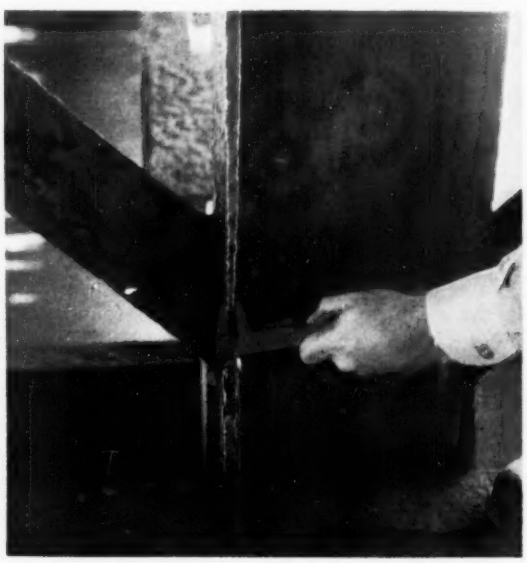
When the results of these tests were compared with actual corrosion rates experienced on steel piling, it was discovered that the corrosion pattern was considerably different on the piling, with the heaviest corrosion occurring at or slightly below the low water level and in the splash zone just above high water level. This discovery led to further experimentation using steel specimens installed vertically and electrically connected to each other, simulating an actual pile. These tests revealed that severe electro-chemical corrosion cells are set up on the piling in such a way as to cause currents to be discharged from some areas of the pile and collected on other areas.

Corrosion is an electro-chemical phenomena and a steel surface corrodes where electrical current leaves the surface to go into the electrolyte. The surface on which current is picked up from the electrolyte is the cathode. The cathode area is always free of corrosion if the density of current pickup is sufficiently high. Steel that is in contact with highly aerated sea water behaves as a cathode and the steel that is in contact with sea water or mud having less aeration behaves as the anode.

Typical underwater corrosion rates which have been observed just below or at low tide level throughout the world are in the order of 10 to 30 mils per year. At some locations accelerated corrosion damage to piling occurs at or beneath the actually removing the pile. The chart shows typical mud line where inspection is impossible without test results.

Preventing Underwater Corrosion

There is another zone that is often subject to heavy corrosion attack. This is the area lying near low tide level. This zone is almost impossible to paint since it is nearly always wet. The use of cathodic protection has prevented corrosion in this zone as well as corrosion attack on the lower regions of the pile. So successful has cathodic protection been that many organizations such as petroleum companies now make it a standard practice to apply cathodic protection to all of their structures that are subject



Nine years' exposure has eaten away over half the 10-inch bare steel H piling at this bridge pier.

to continuous contact with sea water. The oil companies have had years of successful experience with cathodic protection for exposures such as well casings, ballast tanks of tankers, and pipelines.

It now appears that cathodic protection can maintain the underwater and under-mud surfaces of steel piling almost indefinitely. The cost of this protection usually will be in the range of 2 to 2½ cents per year per square foot of underwater surface, and about ½ cent per year per square foot of under-mud surface.

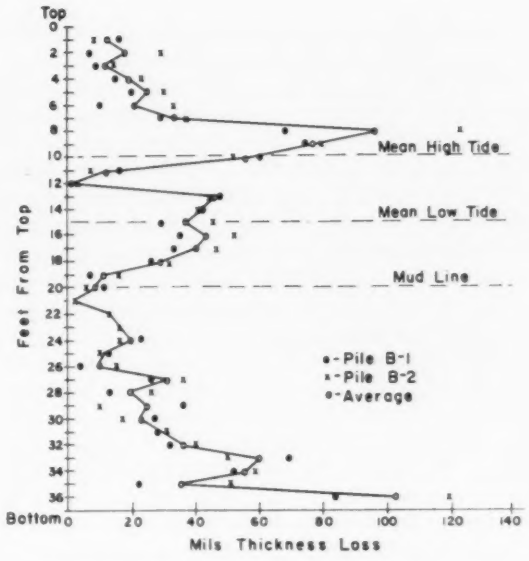
At present we know of no major installation of H piling in the New York harbor area that either does not have an existing cathodic protection system or one that is planned for the near future.

Types of Cathodic Protection

Cathodic protection can be provided by impressed current from a rectifier using anodes of specially treated graphite or a high silicon cast iron, or it can be applied by the use of galvanic current generated by anodic metals such as zinc, magnesium, or aluminum. The choice of rectifier or galvanic anode type of cathodic protection depends upon a number of factors, among which are the electrical resistivity of the soil or water available for anode installation; price of electricity; availability of trained personnel for maintenance; possible methods of supporting anodes to withstand damage from ice, waves, and ocean current action; and proximity to underground or underwater structures owned by others.

If the impressed current type of cathodic protection is installed, it is usually necessary to bond all of the pilings together electrically by means of rods, straps, or cables. This adds to the cost. One advantage of the impressed current method of applying cathodic protection is that current applied can be varied simply by adjusting output taps on the rectifier unit. Disadvantages of the rectifier method of cathodic protection for piers and bulkheads are the complicated wiring system involved, and the difficulties in providing rugged mountings for anodes and leakage-free splices and cables, which are absolutely necessary for trouble-free performance of the system. The feeder cables connecting the positive terminal of a rectifier unit to its associated graphite or high silicon cast iron anodes are subject to damage through fatigue failure resulting from repeated flexing of the cable by water currents or wave action. This is a serious problem which only can be overcome by careful design.

The majority of cathodic protection rectifiers now being installed are the selenium type which appear to have an economic life of about 10 years. This does not mean every rectifier will fail in 10 years, but we frequently have found that the efficiency of selenium rectifiers decreases markedly with age. This can be an important factor in the annual costs of cathodic protection. New germanium or silicon rectifiers may reduce this problem.



Corrosion effects on carbon steel pilings in sea water for 3 years 7 months at Kure Beach, N.C.

The criterion of cost per kilowatt hour as the basis of economic comparison between the rectifier and galvanic anode types of cathodic protection is a completely false method since what is desired is ampere hours, not kilowatt hours of power.

Advantages of Galvanic Anode Protection

The galvanic anode cathodic protection systems, particularly those using zinc, are becoming more popular protection against corrosion of steel in sea water. Advantages of the galvanic anode type of cathodic protection installation include ruggedness of the design (anodes supported by heavy steel rods and welded to the structure), and the absence of connecting wires and troublesome splices. Maintenance is cut to almost nothing.

The life of galvanic anode installations is governed by anode size and the current output obtained, which is a function of anode size and shape. A galvanic anode installation can be made on an average wharf or pier using approximately one large zinc anode per pile. The designed life of the installation can be from one year up to more than 20 years. A period of 10 years is often an economic design life. Since galvanic anodes sacrifice themselves to produce current, they need replacement at the end of their life.

Although large amounts of current are obtained readily with only a few rectifiers, the resulting concentration of current introduces problems, since

cathodic protection ideally requires that the protective current be distributed evenly over the area to be protected. If the current is not distributed uniformly, a large percentage of the current may be wasted through excessive current densities in localized areas. This means that to protect a large pier, for example, using the rectifier system, it is desirable to employ several hundred anodes distributed throughout the structure. Returning a current through the structure to the rectifier requires large cables to avoid excessive voltage drop and consequent unequal protection.

Consider the problem of a sheet steel piling bulkhead two miles long with power being available only at one point. Total current requirements might be 4000 amperes. To avoid the necessity of installing bond cables of several million circular mils in cross-section, it would be necessary to employ about 10 rectifiers evenly spaced along the bulkhead and supplied by a special power line. Similar protection could be obtained by the employment of a number of zinc anodes spaced along the length of the bulkhead with much less bonding required. These would be competitive in price.

Automatic Initial Protection Compensation

It is often desirable, when applying cathodic protection in sea water, to provide extra current capacity in order that the piling be brought under full protection quickly. In a properly designed cathodic protection system using zinc or aluminum anodes this high initial current is automatically provided, for the zinc or aluminum anodes will provide approximately twice as much protective current during the early period until full protective potential is achieved by polarization of the steel surfaces. To do this with rectifiers, the system must be overdesigned. This means that during most of its life the rectifier system will be operating under partial load with lower rectifier efficiencies. Both these factors increase the first cost and operating cost of the installation.

While galvanic anodes can be made of pure zinc, magnesium, or aluminum, it is the present practice to use certain alloying elements to increase their efficiency and performance. Zinc has been used for over 100 years to provide cathodic protection. However, until recently little or no attention was paid to the purity of the zinc and methods of attachment. This often resulted in poor performance. Currently much data are available on the successful performance of high purity zinc as a galvanic anode in sea water, and it is now possible to purchase special, high purity zinc from any of the United States zinc producers.

Since World War II magnesium has come into widespread use as a galvanic anode material. However, it is a very active metal, and it is difficult to achieve with it the long-lived installations that usually are desired for piers, except where the resistivity of the water is considerably higher than sea water. Magnesium as an anode material would be a sound choice for fresh water cathodic protection.

Aluminum when alloyed with zinc is the most recent anodic metal developed for cathodic protection in sea water. Currently the accumulated data on the performance of the aluminum alloy is limited, but it is expected that within a few years its use will increase if the cost of aluminum (per ampere hour delivered) does not increase relative to the cost of zinc.

Millions for Protection

At Ebasco Services we are and have been using considerable quantities of zinc anodes for cathodic protection of piers, bulkheads, and wharves exposed to sea water in various parts of the world. One cathodic protection system now being installed on a large pier in Africa makes use of nearly 500,000 pounds of zinc. Some of our more recent designs call for more than a million pounds of zinc in a single installation with a total current output of over 3000 amperes. These installations actually will have an annual cost less than that of an equivalent rectifier type cathodic protection installation.

There are certain marine locations where explosive or inflammable materials are handled and where it is essential that no sparking occur. The use of zinc anodes, which have a voltage potential of only a fraction of a volt, substantially eliminates the possibility of any spark being produced by the cathodic protection installation. With a rectifier system, even if explosion-proof rectifier cabinets and conduit fittings are used, it is possible to get a spark if a break occurs in one of the non-metallic sheathed cables which necessarily must be used for the connection to the individual anodes. In a rectifier type installation there are concentrations of current and voltages of from 20 to 100 times that of the zinc type installation.

Splash Zone Corrosion

Corrosion rates in the splash zone vary considerably because of differences in wave action and because of the presence or absence of oil or grease on the water surface. We have seen a number of locations where oil and grease from small boat operations have practically eliminated corrosion in the splash zone. In contrast, at tropical and subtropical locations splash zone corrosion is sometimes so severe that sheet steel piling is perforated in only 10 years. Since this high corrosion rate was at locations where only one side of the piling was exposed to sea water

and the piling had an initial thickness of 0.375 inches, it can be seen that the exposed surface corrosion rate was on the order of 35 or more mils per year, a corrosion rate which cannot be ignored in designing or maintaining structures such as steel bulkheads and piling foundations.

Many attempts have been made to provide a long life coating that would act to prevent this heavy splash zone corrosion. Results to date have been disappointing. The average life of most oil paints in the splash zone in sea water is only a few months. Other coating materials such as ordinary coal tar paints often give a somewhat better service life but are unsatisfactory over a long period of time, particularly where the steel surfaces are exposed to the direct rays of the sun. Other types of coatings now being tried are zinc or aluminum metallizing, sheet Monel jacketing, guniting (pneumatically applied concrete mortar), concrete capping or jacketing, grease coatings, sheet neoprene, hot-spray applied plastic mastics, porcelain, plastic adhesive tapes, and zinc-rich paints.

It probably will be several years before all of these coating methods and materials can be evaluated properly, but we are confident that several of these methods will prove satisfactory as a corrosion control measure for the splash zone of steel H piles and sheet steel piling as used in bulkheads.

Reinforced Concrete Piles

Reinforced concrete piles have come into wide use, and they generally are competitive in price with steel piles. They can be made long enough to suit almost any installation. However, corrosion can be a problem in reinforced concrete piles. Concrete is normally a noncorrosive environment for steel. But if certain contaminants or additives are used in the concrete mix, accelerated corrosion of the steel reinforcements can occur, and failure of the concrete pile takes place as a result of cracking caused by internal pressures of corroding steel as it expands with the addition of rust scale to the steel surfaces.

Corrosion of reinforcing steel is more apt to be a factor on reinforced concrete pile surfaces that are under water, since the hydrostatic pressure has a tendency to force salt water between particles of the concrete. It is therefore very important that the concrete in the reinforced concrete piles be of the best quality. It must be nonporous, and it must contain little or no dissolved sodium chloride, calcium chloride, or other salts that are known to be corrosive to steel and which are sometimes used for the purpose of providing antifreeze protection for the concrete piling during construction.

It also should be pointed out that the susceptibility of concrete to spalling because of freezing and thawing action is governed to a large extent by the porosity of the concrete. It is wise to use a high cement content, such as seven or eight bags of cement per cubic yard of concrete.

We believe our opinions concerning reinforced concrete for use in sea water are well substantiated by tests conducted by the U. S. Navy Bureau of Yards and Docks on test piles subjected to freezing and thawing, wave action, and tide action similar to actual pier installations of the same age. Cement lined cast iron water mains have exhibited outstanding life, even when carrying salt water. The thin cement linings used in water mains are rich mixtures of cement and sand that are nonporous and strong.

Advice to Pier Designers

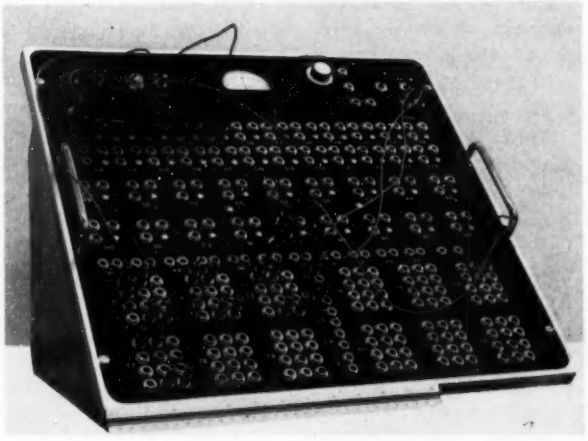
Cathodic protection and splash zone corrosion control measures should be considered during the early design phases so that optimum economies can be realized. Examples of problems closely allied to corrosion and corrosion control on marine structures can be summarized as follows:

¶ Weight of structural sections. It has been customary to call for a considerably thicker H pile or sheet steel piling than actually is required for mechanical strength. In the past this corrosion allowance also was customary in the design of pipelines, but I calculated recently that on one large pipeline from Texas to New York the use of cathodic protection saved over 100,000 tons of steel because it was possible to use a thinner wall pipe. Similarly, lighter piling can be used if cathodic protection is provided.

¶ Painting of piles. The cost of surface preparation and painting of surfaces of piling that will be underwater or under-mud after installation can be eliminated when cathodic protection is employed. We have found that painting costs easily can exceed the entire first cost of a properly designed cathodic protection system.

¶ Bonding of individual piles. If the rectifier type of cathodic protection is to be installed, bonding is imperative; with the zinc or aluminum type of cathodic protection installation bonding may or may not be necessary depending upon the design.

¶ Providing reinforced concrete caps for piles. Reinforced concrete may have a short life in sea water unless fresh water is used in the mix and the mix contains enough cement per cubic yard. Chemical additives corrosive to steel should not be used. In some areas where there is little wave action and there is oil or grease on the water surface almost continually it is possible to eliminate the pile caps entirely. Find out what the experience has been on other similar structures in the vicinity before you decide whether or not to cap your piling. ▲▲



Practical working model of a structural simulator.

A Structural Simulator . . .

For Static Analyses

FREDERICK L. RYDER

Frederick L. Ryder has been working with electromechanical and analog computers and instruments ever since he received his BS in electrical engineering from New York University in 1938. Besides devising test equipment for guided missiles, engineering aircraft instruments, and designing computers, Ryder found time to get his masters degree from Brooklyn Polytechnic Institute in 1947 and a doctorate in engineering from New York University in 1951. At present Ryder is a member of the scientific research staff at Republic Aviation, in Farmingdale, Long Island, working on the development and embodiment of electrical analogs of structures. Ryder has obtained several patents for mechanical and electrical devices, including special purpose electrical analogs. He is a registered professional engineer in New York State and also a member of Iota Alpha and Sigma Xi.

A STRUCTURAL SIMULATOR is an electrical analog device for the experimental analyses of statically loaded framed structures, including 2- and 3-dimensional trusses and rigid frames. For each problem the analog is connected so as to bear a pictorial relationship to the structure, with the result that there is in general a one-to-one correspondence between electrical and structural elements. This leads to the following advantages:

¶ The governing equations need not be derived.

¶ The relationships between structural and electrical quantities are readily apparent to the intuition. This means that the simulator is useful as an educational tool since its operation leads to better intuitive appreciation of structural behavior and of the interrelationships of structural parameters.

¶ The response of the entire structure to the modification of a single element is determined and interpreted easily and directly. This makes the simulator particularly useful in practical design where it usually is desired to find the best choice of members for a given structural configuration rather than to analyze a single, completely defined structure.

¶ The sensitivity of the simulator to errors in its individual elements is no greater than the sensitivity of the structure to errors in its elements. This means a less costly instrument, since the necessity for extremely precise components is eliminated.

Simulator Is Fast . . .

In the conventional analog computer, on the other hand, the governing equations must be derived explicitly, and often laboriously; the analog network bears a pictorial relationship to the equations rather than to the structure, thus increasing the difficulty of intuitive interpretation of results; the modification of a single structural element affects many elements in the analog circuit; and finally, since each coefficient in the equations is affected by a plurality of

structural parameters, the sensitivity of the computer to errors in its individual elements may be far greater than that of the structure.

Digital computers usually require considerable analytical preparation of each problem, and also, the rather complicated programming must be changed for structures of different configurations.

As with other automatic computational aids, the simulator solution may be checked manually to guard against faulty use or operation of the instrument. For indeterminate structures such a check generally requires only a small fraction of the time that would have been required for manual solution, and ordinarily need be done only for the final choice of members arrived at during an investigation.

. . . Accurate and Simple

Experimental work with the structural simulator[1, 2] has yielded typical errors of the order of one or two percent referred to maximum values in the structure. This is tolerable in most practical work in view of the errors which are conventionally accepted with regard to loads, conditions of end fixity, details of fabrication, effective length and cross-section of members resulting from the consideration of joint connections, and neglect of direct shear and tensile deflections in bending members.

While the analysis of structures by the method of least work and by Castigliano's theorem concerning work is universally applicable to all statically loaded linear structures, it often is not as suitable for manual solution as other methods – notably the method of moment distribution for rigid frames. However, the simulation of structures by electrical networks can be understood far more simply by considerations of work or energy than by other methods. Further, the labor ordinarily associated with energy methods of analysis is performed automatically by the simulator, thus removing the chief objection to the method. Hence, the operator of the structural simulator should have or should develop a good understanding of the principles of work. In learning to appreciate these universally applicable principles with the aid of the simulator, both the practicing engineer and the student can acquire a skill which also is useful in the manual analysis of the many structural problems for whose solution routine methods have not been found.

The electrical knowledge required of the operator concerns only simple fundamentals. In particular, the simulator, unlike conventional analog computers, is basically nonelectronic. It is built almost entirely of resistors and transformers.

Basic Principles

It is well established that the moments, forces, deflections, and slopes in statically loaded linear framed structures always can be determined by use of two principles:

¶ *The theorem of least work,* which states that the redundant forces and moments (those which cannot be evaluated by considerations of equilibrium alone) assume such values as to minimize the total work of deformation of the structure. This enables one to solve for the redundants without regard to deflections or slopes.

Work W is written as a function of the applied forces and moments, the redundants, and the elastic constants. The partial derivative of the work with respect to each redundant then is set to zero. This method yields the same number of equations as the number of redundants and therefore permits their evaluation.

¶ *Castigliano's theorem,* which states that

$$D_a = dW/dF_a \qquad (1)$$

where F_a is applied force (or moment), and D_a is the deflection (or slope) measured in the direction of F_a. In performing this differentiation the redundants can be temporarily considered as independent applied forces or moments. If D_a is desired at a point where the corresponding force or moment F_a does not exist, one pretends that the latter exists and modifies W accordingly, and then lets F_a become zero after the indicated differentiation has been performed.

Analogous Principles

For networks using resistors and ideal transformers energized by prescribed alternating currents at a single frequency and phase angle, analogous principles have been developed[3]:

¶ *The theorem of least power,* which states that the redundant currents (those which cannot be evaluated by Kirchhoff's law of current-continuity, taking into account the effects of the transformer turns ratios on the currents) assume such values as to minimize the power dissipated in the resistors. This enables one to solve for the redundants without regard to voltages by writing the power P as a function of the prescribed and redundant currents and the resistors, and then setting its partial derivative with respect to each redundant to zero.

¶ *A Castigliano-like theorem for electrical networks,* which states that

$$V_a = d\,(P/2)/dI_a \qquad (2)$$

where I_a is a prescribed current entering the network and V_a is the voltage, measured above any convenient datum or ground, of the point where I_a enters. (Sometimes it is more convenient to define V_a as the voltage rise of a current generator whose prescribed output is I_a, measured in the direction of I_a.) If V_a is desired at a point where the corresponding current I_a does not exist, one pretends that the latter exists and modifies P accordingly, and then

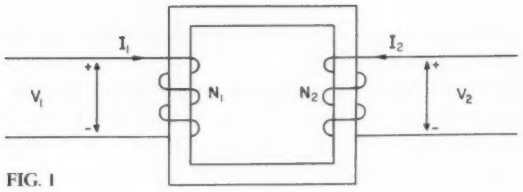


FIG. 1

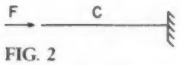


FIG. 2

FIG. 3

lets I_a become zero after the indicated differentiation has been performed.

Consideration of these facts reveals a far-reaching analogy between the structure and the electrical network.

Structure	Network
Equations of equilibrium	Equations of current-continuity, including effect of transformer turns ratios on currents.
Work of deformation, W	Half-power dissipated in resistors, P/2
Force or moment, F or M	Current, I
Deflection or slope, D or Θ	Voltage, V
Compliance (reciprocal of stiffness) with respect to the force or to the moment, C or K	Resistance, R

The last item follows from the following characteristic expressions for work and power:

$$W = F^2C/2 \text{ or } M^2K/2 \qquad P/2 = I^2R/2 \qquad (3)$$

$$W = D^2/2C \text{ or } \Theta^2/2K \qquad P/2 = V^2/2R \qquad (4)$$

Further characteristic expressions where the analogy is consistently carried out are as follows:

$$D = FC, \text{ or, } \Theta = MK \qquad V = IR \qquad (5)$$

Scale Factors. Let f generally denote the scale factor represented by the ratio of structural quantities to corresponding electrical quantities. Thus, in a structure not subject to moments and their associated slopes, as in a pin-connected truss:

$$f_F \equiv F/I \qquad f_D \equiv D/V \qquad f_C \equiv C/R \qquad (6)$$

By Eqs. (5) it is easily shown that only two of these f's are arbitrary, the third being subject to:

$$f_D = f_F f_C \qquad (7)$$

When moments and slopes are of interest, as in rigid frames, it is usually convenient to multiply force by a convenient length so as to change it to a moment before representing it in the simulator, and correspondingly to change deflection to a slope by dividing it by a convenient length. The scale factors then are:

$$f_M \equiv M/I \qquad f_\Theta \equiv \Theta/V \qquad f_K \equiv K/R \qquad (8)$$

where the scale factors must satisfy the following, by Eqs. (5):

$$f_\Theta = f_M f_K \qquad (9)$$

The Ideal Transformer

Since ideal transformers figure so prominently in the electrical-structural analogy, it is important to understand their properties. In Fig. 1 the currents, voltage rises, and numbers of turns are as indicated, each turn's value being considered positive when its associated current, when positive, produces core flux in a single prescribed direction. Since the net ampere-turns of an ideal transformer must be zero:

$$N_1I_1 + N_2I_2 = 0 \qquad (10)$$

Also, since transformer voltage rise is proportional to the number of turns:

$$V_1/N_1 = V_2/N_2 \qquad (11)$$

With these equations it is easy to show that the net power absorbed by the ideal transformer is zero.

The practical transformer imperfections which directly introduce error into the analog are the series resistance of each winding (producing energy loss depending essentially on current only) and the effective shunt resistance. Shunt resistance, which simulates the core loss, can be referred to either winding, and produces energy loss dependent essentially on voltage rise only. These imperfections must be taken into account.

Analogs of Individual Members

Bar Under Compression. Fig. 2 shows a bar under compressive force F. The length of the bar is L, its cross-section (assumed constant) is A, and its modulus of elasticity is E, so that its compliance is:

$$C = L/AE \qquad (12)$$

It is assumed that the bar is not slender enough to tend to buckle as a column, so that if the direction of F is reversed its associated deflection merely changes sign.

An electrical analog of the bar is shown in Fig. 3, where the current I simulates force F, and the resistor R simulates C. Since half the electrical power

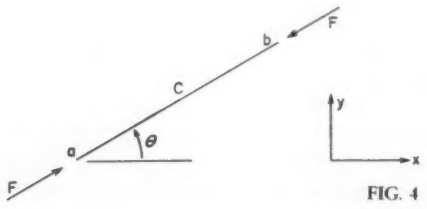


FIG. 4

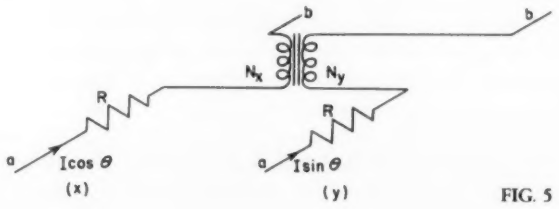


FIG. 5

$(I^2R/2)$ simulates the elastic energy $(F^2C/2)$, then by the energy theorems the voltage V at the ungrounded end of the resistor must simulate the deflection D at the free end of the bar, measured in the direction of F. In this simple example the analogy between voltage and deflection can be proved very simply without the aid of the energy theorems, by noting that $V = IR$ and $D = FC$.

Bar in Compression, Inclined to Coordinate Axes. Fig. 4 shows a bar similar to Fig. 2, except that it is inclined at angle Θ to the x-axis of a set of rectangular coordinate axes x, y. Bars of this type occur in pin-connected trusses, where F is maintained by contiguous members or external forces.

The analog consists of two branches arranged as in Fig. 5, fed by currents from adjoining branches or external current sources, not shown. The current in the x-resistance is $I\cos\Theta$, which simulates the x-projection of force F, considered to be exerted in the arbitrarily selected direction a-b; and similarly for the current in the y-resistor. The value of the transformer turns N_x and N_y in the x- and y-branches is such that these currents are appropriately related. Hence by Eq. (10):

$$N_x/N_y = -\tan\Theta \qquad (13)$$

The total electrical power dissipated is I^2R, as in Fig. 3. Hence the energy theorems indicate that, in the x-branch, the excess of the voltage at a over that at b simulates the x-component of the deflection of end a of the bar over that at b; and correspondingly for the y-branch. Furthermore, since the voltage across the x-resistor, $IR\cos\Theta$, simulates the x-component of the bar deflection FC (deflection due to elongation, in this case negative), the voltage across the associated transformer winding must simulate the component of bar deflection due to rotation of the bar as a whole, which in pin-connected trusses commonly produces deflections of the same order of magnitude as elongation. This same analysis holds true for the voltage across the y-winding.

The conclusions just reached would have been more difficult to arrive at without the aid of the energy theorems. A further advantage of the energy method is that it often permits compensation for transformer imperfections, as well as simplification of the circuitry, to be made by inspection. In Fig. 5, for example, the transformer winding resistances may be incorporated within the branch resistances, and one of the branch resistances may be eliminated providing the other is increased by such an amount that the total power dissipated remains unchanged.

Beam Member. Fig. 6 shows a typical member of a rigid frame, loaded at its ends only by moments and shears exerted on it by contiguous members and by external forces and moments. The member is initially straight and its length is L, its modulus of elasticity is E, and its constant moment of inertia effective in bending is I. Deformation due to direct shear (and tension, if it exists) is considered negligible, and the bending displacements are considered very small compared to L. The applied end-moments and their associated elastic slopes Θ_a and Θ_b are considered positive when counterclockwise, the shear S is considered positive when it tends to rotate the beam counterclockwise, and the relative deflection D'_{ab} will denote the deflection of b, in the direction of positive shear, measured from the extended tangent through a; and correspondingly for D'_{ba}. By equilibrium considerations we write:

$$M_{ab} + M_{ba} + SL = 0 \qquad (14)$$

By elementary structural analysis the work of bending W in the beam can be expressed thus:

$$2W = L/EI\,[(M_{ab})^2 + M_{ab}SL + (SL)^2/3]$$
$$= L/EI\,[(M_{ba})^2 + M_{ba}SL + (SL)^2/3] \qquad (15)$$

Fig. 7 shows an electrical circuit which has been devised[1] to satisfy the above equations. Points a and b represent the ends of the beam in Fig. 6, and the various currents are designated by the symbols of their structural counterparts. The resistance values are given in terms of:

$$K = L/EI \qquad (16)$$

where the quantity on the right has the dimensions of bending compliance. The transformer is assumed to have a unity turns ratio, of polarity dictated by the indicated values of current in its two windings.

Current-continuity considerations yield an equation identical to Eq. (14), which was obtained by equilibrium considerations. Also, the total power dissipated in the two resistances is easily shown to have the value in Eq. (15). Hence, by the energy theorems, the voltage rise from a to b in the analog simulates the increase of the slope from a to b in the beam, as implied by the slope designations in

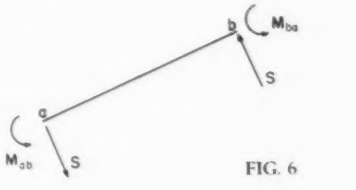


FIG. 6

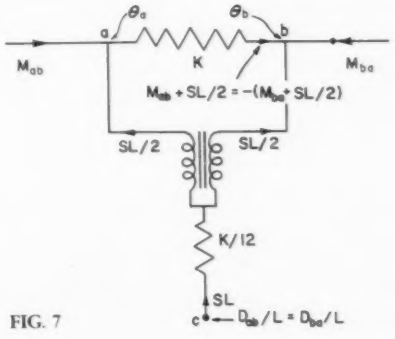


FIG. 7

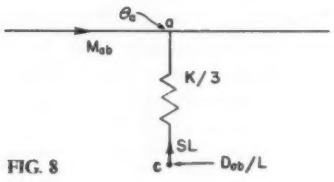


FIG. 8

Fig. 7. Similarly, voltage rise from b to c in the analog represents D_{ba}/L, and the voltage rise from a to c represents D_{ab}/L. Then by Kirchhoff's second law the voltage at c equals:

$$\Theta_b + D_{ba}/L = \Theta_a + D_{ab}/L$$

which by purely geometrical considerations is seen to equal $D_{ba}/L = D_{ab}/L$, where D_{ba} and D_{ab} are the same as D'_{ba} and D'_{ab} except that they are measured from the tangent to the undeformed beam; the voltage at c is designated accordingly.

These conclusions would have been more difficult to establish without the use of the energy theorems. Another advantage is that these theorems permit two improvements to be made by inspection:

¶ If member a-b in Fig. 6 is known to be pivoted at b so that M_{ba} must be zero, then Fig. 7 reduces to Fig. 8, which by inspection of Eqs. (14) and (15) satisfies both the equilibrium and work requirements, with the consequent saving of a transformer and a resistor. All previous parameters, therefore, remain correctly simulated, except that Θ_b does not appear in the analog. If desired, however, it can readily be calculated analytically in terms of the voltage D_{ab}/L at c, with the result:

$$\Theta_b = (3D_{ab}/L - \Theta_a)/2 \qquad (17)$$

¶ For easy compensation for the effects of the series resistances in the windings of the transformer of Fig. 7, we subtract one-fourth their combined value from the resistance value K/12, with the result that the power expression is the same as though the transformer had no series resistances. Further, if the relatively small resistance of initial value K/12 is too small to permit accurate measurement, it can be multiplied by 4 and placed in series with either of the transformer windings, for this does not change the power dissipation.

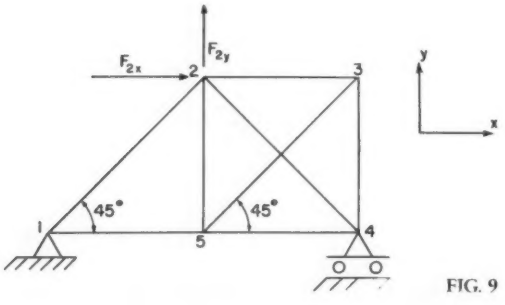


FIG. 9

Several examples will illustrate the principles used in devising analog networks for the simulation of complete structures.

Pin-Connected Truss. Fig. 9 shows an idealized pin-connected truss with arbitrary rectangular coordinates as indicated. It is required to find the reaction forces and the forces in all members, as well as the deflections of all joints. The structure is readily seen to be redundant to the first degree although this fact is of no direct interest in constructing the analog.

The analog is shown in Fig. 10, and is in two parts, (x) and (y), to simulate corresponding components of force and deflection. The x-network consists of those branches that have x-projections, and the y-network is made up of branches with y-projections. Branches which have both x- and y-projections are connected as in Fig. 5 by transformers whose windings are represented by small circles for simplicity. The electromagnetic links between the respective pairs of windings a-a′, b-b′, and c-c′ are omitted from the drawing. The resistors, designated in terms of compliance C are also as in Fig. 5, and the branch currents in the analog are designated as appropriate components of the branch forces $F_{1\text{-}2}$, $F_{1\text{-}3}$ . . .

Joints 1 and 4 in the y-network are grounded, since the y-component of deflection is zero at these points in the structure. Similarly, joint 1 in the x-network is grounded (but not joint 4). Currents F_{2x} and F_{2y}, simulating the corresponding load components, are supplied by current generators.

Analog circuit validity can be proved as follows:

¶ If branch forces F are regarded as indicating compression when positive, the equations of current-continuity in the analog may be shown to be identical with the equations of equilibrium in the structure, provided that currents entering the network at grounded points are taken to represent reaction components. For example, F_{1x} is the x-component of the force applied by the support at joint 1 to the structure.

¶ The power dissipated in the two typical electrical branches which simulate each structural branch simulates twice the elastic energy of the branch.

Hence, by the theorems of least work and least power, the electrical currents must correctly simulate their structural counterparts. By Castigliano's structural theorem and its electrical counterpart, the voltage at joint 2 in the x-network represents the x-component of deflection at joint 2 in the structure, and correspondingly for the voltage at joint 2 in the y-network. The loads at joints 3 and 5, as well as the x-load at 4, happen to be zero. If they were present, however, they would be similarly simulated by currents introduced at the appropriate electrical joints. Hence the voltages at these joints represent corresponding components of

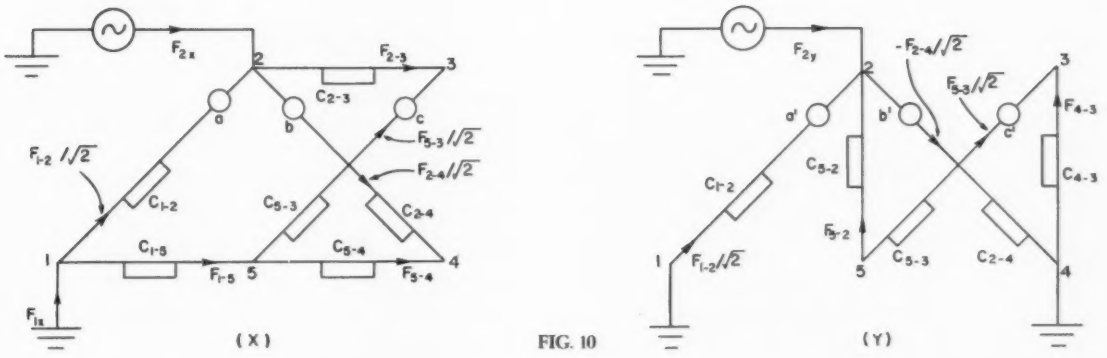


FIG. 10

deflection at appropriate joints in the structure. The fact that the voltage at grounded points is zero is consistent with this general analogy between voltages and deflections.

Rigid Frame. Fig. 11 shows a rigid frame consisting of members of the type discussed in connection with Fig. 7. X_2 is an applied load, and the other external forces and moment are unknown reactions. The problem is to determine the reactions, as well as the moment, slope, and deflection at the end of each branch. The reference directions for displacement components x and y and for slopes are as indicated; the reference direction for moment acting on the end of any beam will be the same as for slope.

Preparatory to drawing the analog circuit use is made of equilibrium considerations to indicate the value of shear on each branch in terms of force X_2 and as few other forces as possible. This can be done with a single other force, X_4. By inspection, the moments also can be written in terms of X_2 and X_4, so that the structure is indeterminate to the first degree (the redundant being X_4), although this is of no direct interest in setting up the analog.

Next a network is drawn similar to Fig. 7 for each member and connected in a pictorial simulation of the structure as in Fig. 12, where the individual network for each beam is symbolized by a triangle for simplicity. Joint 1 is grounded to simulate zero slope in the structure at this point, and joint 4 is left open to simulate zero moment. Considering only the portion of the network above the heavy horizontal line, we designate the shear currents introduced at the apex of each triangle in accordance with Fig. 7. The equations of moment equilibrium in the structure now will be found identical to the equations of current-continuity in the analog, if the current introduced at each branch end is taken to simulate the moment applied to that end by other branches and by external forces and moments. For example, current M_1 is considered to simulate the reaction moment M_1, and current $M_{2\text{-}1}$ is considered to simulate the moment exerted by branch 3-2 on branch 2-1 at joint 2. Also, the power dissipated within each triangle must correctly simulate twice the bending energy of the corresponding beam, as in Fig. 7.

By suitable use of ideal transformers and current generators the shear currents are interconnected in accordance with their designations. The current proportional to X_2 must be prescribed in advance, since the load X_2 is prescribed, and the various currents proportional to X_4 must be maintained in correct ratios with each other, either by direct connection or by means of transformers. Any one of the many ways of satisfying these requirements,

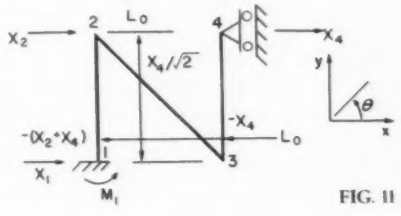


FIG. 11

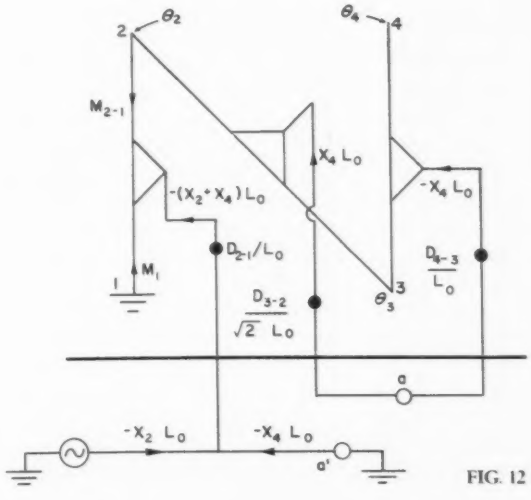


FIG. 12

including the one shown below the heavy horizontal line of Fig. 12 (where a and a′ are associated transformer windings), will be acceptable. When these connections are made, the various currents must correctly simulate their structural counterparts in accordance with the theorems of least work and least power. Also, the voltages at the branch junctions must represent appropriate values of slope Θ, and the voltages at the apices of the triangles must represent appropriate values of D/L in accordance with the voltage designations of Fig. 7. The D's also can be readily interpreted in terms of rectangular components of joint deflections.

Additional Types of Structures. The techniques illustrated in connection with Figs. 9 and 11 can be extended by more or less obvious methods to include other types of statically loaded structures.

Any linear framed structure, whether 2- or 3-dimensional, whether the joints are pin-connected or rigidly connected, can be handled. In general, the moment acting on a beam must be resolved into a torsional-moment component and two bending-moment components acting on the principal axes of each member. Where there are curved beams of variable section, loaded at intermediate points as well as the end-points, equilibrium and energy expressions corresponding to Eqs. (14) and (15) must be derived by structural analysis of the individual members and corresponding networks must be devised[1]. Structures containing plates and shells which can be replaced by framed structures to within a satisfactory degree of approximation can be handled like framed structures.

Structures containing nonlinear members (whether the nonlinearity is due to elastic instability as in columns or to a curved stress-strain relationship) can be handled by replacing each such member by a linear member whose elastic constants vary with load in such a way as to duplicate the end-effects of the actual member. In using the analog the loads are increased in successive steps from small values, and the elastic constants are suitably adjusted after each increment of load. Such an iteration process is also useful when the deflections are large enough to alter significantly the equilibrium relationships. Then the change in these relationships is taken into account in the analog after each increment of load is applied. A further use of the iterative process is in aerolastic problems, where the loads themselves depend on the displacements.

Applied displacements as well as applied loads can be represented by voltage sources. The effects of thermal expansion, as in piping networks carrying hot liquids, can be simulated by regarding the thermal expansions as applied deflections.

In special problems, such as in shallow trusses subjected to high longitudinal compression, the transformer voltage rises (which in trusses have been shown to simulate deflections due to branch rotations) are relatively large, thus introducing relatively large errors because of the effective shunt resistances of the transformers. These errors may be reduced by various methods of compensation for the shunt resistance.

Demonstration Model

The demonstration model of an analog instrument shown in the photograph contains the following main components:

¶ Twelve transformers having turns ratios adjustable by tap selection in steps of 1 percent, from zero to 100 percent; the twelve tap groups are distributed across the lower portion of the panel.

¶ A voltage measuring circuit consisting of an indicating ten-turn potentiometer connected so as to null the unknown voltage through a galvanometer; currents may be measured by measuring the voltage drops across known resistances.

¶ Forty-two rheostats having various values of total resistance, each having provision for adding a fixed resistance in series; the rheostats are set to desired values by a Wheatstone bridge made up of fixed resistances and the nulling circuit.

¶ Numerous sources of voltage which, in conjunction with relatively large series resistances, may act as current generators. The tapped transformers may be used to maintain desired ratios among currents.

¶ Patch cords to interconnect the various elements.

The analog instrument is powered by a small 400-cycle oscillator.

Working Model

A practical working model of such a device would have many more elements than illustrated and, in addition, would have other improvements. Provisions would be made for measuring current directly. Taps would be provided for setting desired resistance values, thus affording a visual indication of the values. Resistors would be made portable, with provision for interspersing them among the transformers so as to obtain good pictorial similarity of the analog hardware to the analog circuit diagram, and therefore to the problems of the structure being simulated. ▲▲

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4. "Electrical Analyzer of Structures," U. S. Patent No. 2,766,933, granted to F. L. Ryder, October 16, 1956

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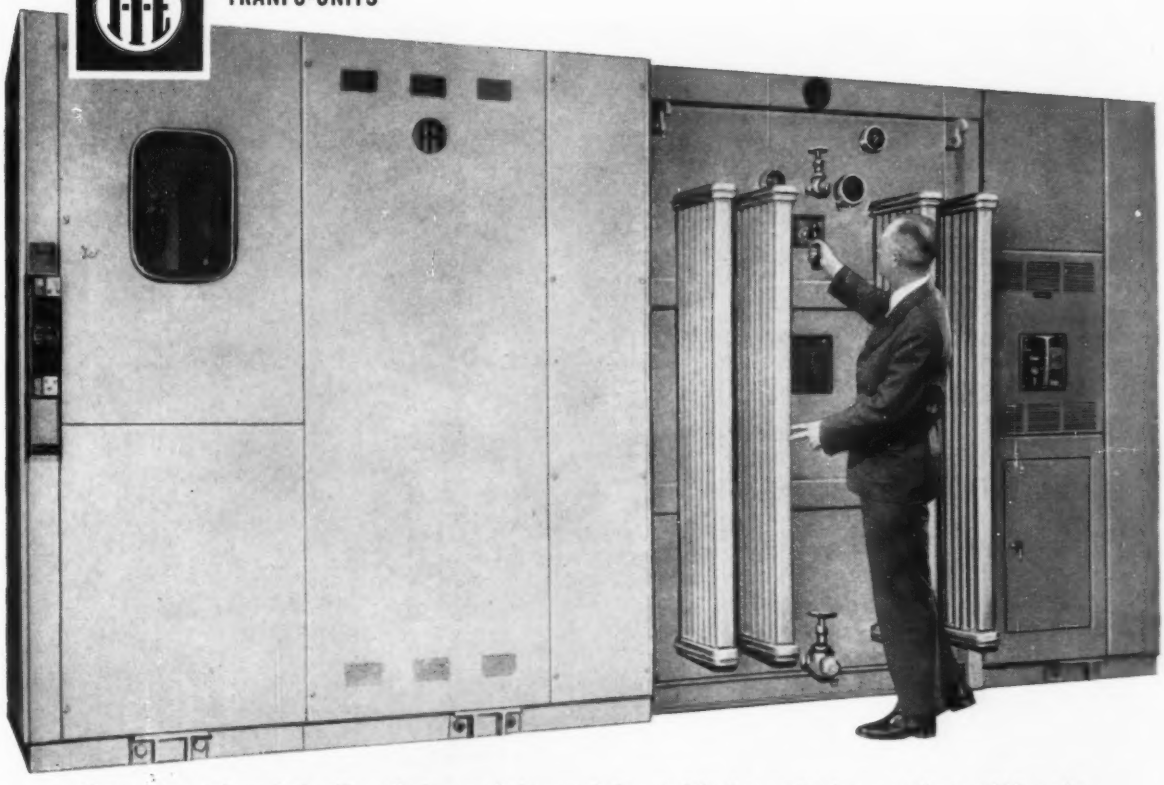

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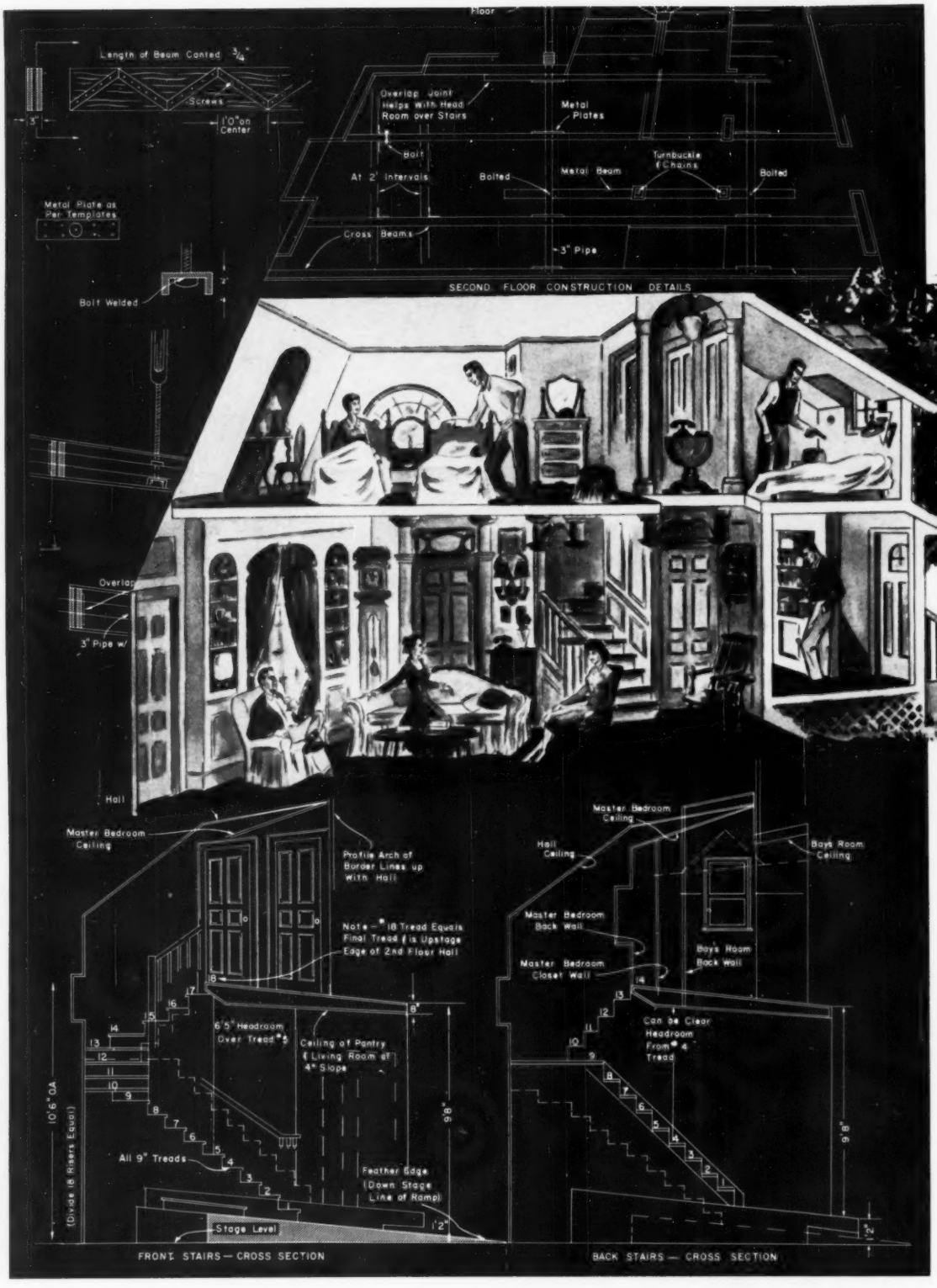

Floor
Length of Beam Canted 3/4"
Screws
3"
1'0" on Center
Overlap Joint Helps with Head Room over Stairs
Metal Plates
Bolt
At 2' Intervals
Bolted
Metal Beam
Turnbuckle & Chains
Bolted
Metal Plate as Per Templates
Cross Beams
3" Pipe
SECOND FLOOR CONSTRUCTION DETAILS
Bolt Welded
Overlap
3" Pipe w/
Hall
Master Bedroom Ceiling
Profile Arch of Border Lines up with Hall
Note — 18 Tread Equals Final Tread & is Upstage Edge of 2nd Floor Hall
6'5" Headroom Over Tread #5
Ceiling of Pantry & Living Room at 4° Slope
All 9" Treads
Feather Edge (Down Stage Line of Ramp)
Stage Level
10'6" OA
(Divide 18 Risers Equal)
98"
12"
FRONT STAIRS — CROSS SECTION
Master Bedroom Ceiling
Hall Ceiling
Boys Room Ceiling
Master Bedroom Back Wall
Master Bedroom Closet Wall
Boys Room Back Wall
Can be Clear Headroom From #4 Tread
9'8"
BACK STAIRS — CROSS SECTION

Drawing & set design by Howard Bay

Theater Stage Engineering— A New Field For The Consultant

ROYCE EMERSON and LOUIS KENNEL

THE THEATER is a field to which the consulting engineer probably has given little professional thought. Yet he has much to contribute. It is true that the theater has been doing wonders with all techniques, and the ancient apprentice school method of training has turned out many experts in stage design but, generally speaking, the modern theater is not making use of new materials and methods as it could be.

CE exclusive

A consulting engineer thoroughly familiar with modern construction materials and the latest mechanical and electrical equipment could be of enormous assistance to the scenic artist and the stage designer. First, however, he must understand something of the theater and its operations.

Scenic artists and stage designers are to the producer of a play what the architect is to the owner of a building. The designer converts his ideas indicating his interpretation of a play and its sets into a series of drawings. He first designs a floor plan for each set and presents these for the director's approval. These plans may have to be redesigned a number of times to satisfy the director's interest in acting areas, scene build-up, and actors' movements. They must express his concept of the required balance and harmony and the special effects he desires. When a decision has been

Studio heads inspect model of an all-steel cantilevered set. Actual set was suspended from a central column.

reached and final floor plans drawn, a perspective sketch is made to illustrate the three-dimensional appearance of the set. This is followed in most instances by a scale model, which is studied by the director, costume designer, and lighting expert.

The designer, still in the role of stage architect, may or may not supervise the set construction. However, he does prepare a number of detailed working drawings for the builder. He also prepares scale elevations to facilitate the scenic painter's job and to assure proper color selection and line design. He often is expected to work out a property plot for the stagehands and a lighting plot for the electrician unless there is an electrical expert to assume this particular duty.

Stage Designers Need Engineers

It is clear that the stage designer of today must be a creative artist, an architect, and a technician. He is in somewhat the same position as the architect of a generation ago. He is expected to be both artist and engineer. It is, of course, difficult to be both, and all too frequently the best architects are the poorest engineers. This was recognized in architecture when the architects began to call in consulting engineers to handle structural, mechanical, and electrical aspects of design. This permitted the architect to concentrate on the more esthetic aspects of his profession and furnish the client a more competent engineering service.

This same evolution must take place in the theater. The stage designer is going to have to concentrate on esthetics and leave engineering to another specialist – presumably a consulting engineer. The more the theater turns to electrical and mechanical devices, and the more complicated the stage settings become structurally, the more an engineer is needed.

New Materials, Methods Wanted

Engineers should be able to suggest better materials and develop better and more practical methods of construction to solve the problems of the artist. This is true not only for the large metropolitan theaters but also for the smaller amateur productions that are now so handicapped by lack of good equipment and meager technical knowledge. There are many theatrical service companies who supply materials and issue catalogs that explain ordinary scenic construction problems. While these firms do a good job of equipment design, an interested engineer could find many ways to improve the application of this equipment and find new materials for stage construction.

Any engineer interested in undertaking projects for the theater must understand the scenic designer and how he works, just as the engineer working for architects must understand the architectural profession. In fact, consulting engineers interested in theater projects should know not only the scenic

designer but should understand something of the spirit of the theater. Only then can the consultant do a good job, for it is often necessary to diverge from the proper engineering answer and select a less likely approach but one that suits the spirit of the play.

The playwright creates an illusion of life for our enlightenment or entertainment. He goes about this in any one of a number of ways. The scenic artist must understand the author's approach and must create an illusion of environment in which the characters of the play appear to belong. The playwright describes in words this environment, but the full significance of it is hidden in the play itself, and the scenic artist must grasp that significance in order to interpret it. The scenic artist is further handicapped in that the author's descriptions of sets usually fail to take into consideration the limitations of shape and space of the stage of any particular theater or the limitations imposed by the customary set construction methods. We have, then, a situation in which the set designer must thoroughly understand the author and must envision the proper physical environment for each act and scene. It is here that the consulting engineer could come into the picture by transferring this design concept into a workable setting.

The producer selects the designer for his play in the same way an owner selects an architect. The designer then reads the script and tries to capture the general impression and mood. He determines the particular style of setting he will use to express that mood. He discusses this with the director to be sure that his ideas will satisfy him, and then he secures the approval of the producer, who is interested in whether these ideas can be accomplished within the budget.

Before any sketches or drawings are made, there must be agreement about the style. First, should it be realistic or nonrealistic? Realistic style attempts an illusion of off-stage life. The nonrealistic merely aims at a theatrical expression of life.

Each of these styles and its substyles has it own singular problems of construction, painting, and stage decoration. Some are limited to a particular type of play while others may be used for a number of types. Realistic drama may use any subdivision of the realistic style; farce, satire, and problem plays are inclined to the nonrealistic approach. But no matter what style setting the designer may choose, he must adhere to the basic principles of good design, whether these be depicted in line, color, or mass. He must be careful to balance all of these elements to achieve the esthetic end he desires. It must be remembered, however, that all this is subject to the materials and methods at his disposal, and the consulting engineer could do much to open new horizons.

Drawbacks of the Theater Itself

One of the designer's primary limitations is in the theater itself. There are many types of theaters, and only a few offer all that the designer would like. The open-air theater is an imitation of the ancient Greek theater with its permanent, formal staging. This gives little scope to the designer in selection of style and type of scenery. Then, there is the open-air theater on the green with its temporary platform and stage. This construction is extremely limited as to the use that can be made of scenery and lighting. The theater-in-the-round permits the designer to express himself only through furniture and small decorations. The school auditorium generally has an open shallow stage meant only for speakers, yet the designer must manage to fit scenery on it despite all the physical handicaps.

The conventional theater offers a great deal more range for the scenic designer but, again, stages and theaters vary. The stage opening, or proscenium arch, may be 40- to 45-ft wide in those theaters designed for musical comedies. Most legitimate theaters used for drama have stages 28- to 32-ft wide. Yet, even when he has a wide stage, the de-

Workman constructs "gingerbread" house of cyrafoam and wood for "Hansel and Gretel" TV spectacular.

"Hansel and Gretel" tree of welded steel, plastic-painted window screen that glows when backlighted.

signer cannot always make the best use of it, for he knows that plays move from theater to theater and he must design sets for the minimum sizes.

Although the height of the proscenium arch may be 13 to 14 feet, a drape border, known as the grand drape, is lowered to 11 or 12 feet above the stage to mask the ceiling or the overhead lighting apparatus. The ceiling of the stage rises to about twice the height of the opening to permit flying (raising) scenery and lighting equipment. A series of beams run across the stage a foot or so above the ceiling, and this grid is utilized for mounting sheaves through which ropes are passed to lift the sets. In older theaters these ropes were pinned to a fly-gallery to hold the pieces in place. Sandbags were used as counterweights to assist stagehands in the gallery in lifting.

More modern theaters make use of a mechanical counterweight system so that scenery can be raised by stagehands on the floor.

In theaters without a grid, such as school auditoriums, the designer finds shifting and changing scenery very cumbersome, since it must be stacked on the stage floor, either at the sides or at the back of the stage, where it further limits stage area. Certainly there is need for well-engineered machinery that would make it possible to raise scenery on gridless stages – perhaps with a cantilever truss.

Types of Scenery Settings

While the set style that is selected is primarily an esthetic problem and well within the province of the stage designer, types of sets are more an engineering problem. For example, the unit set involves a collection of distinct and separate pieces of scenery arranged in various ways to give entirely different effects. A play calling for three or four different scenes might be staged by arranging the available pieces of scenery to satisfy the various backgrounds required. Sometimes a permanent structure with a number of openings in which various pieces are placed – doors, windows, balconies – might satisfy the required changes. Sometimes particular pieces are painted differently on opposite sides and by reversing and rearranging them a completely different effect is obtained. Some designers call this a reversible set, but actually it is still a unit set.

The most inexpensive set is the curtain set. Heavy dark drapes or curtains take the place of walls. Here, light plays a considerable role. Pieces of scenery may be placed against the curtain to suggest a particular location. These pieces may be realistic or nonrealistic depending upon the mood of the play. Sometimes a profile of realistic scenery is placed against the curtain to stimulate the impression of an actual room or outdoor scene.

Another type of scenery, known as prism sets, is supposed to have been used as far back as the ancient Greeks. Sets of this type consist of three canvased frames called flats, hinged together at two edges and hooked together on the third. The prisms thus formed may be isosceles, equilateral, or irregular. By painting each side of the prism in a different color, they may be used for three different changes of sets. Four or six prisms can be arranged in a great number of combinations, permitting a wide variety of set changes. These can be combined with other scenic elements, such as platforms, doors, and windows to supplement the variations. Unhooked, these prisms may be stored as flat surfaces, yet when standing they need not be braced as are ordinary flats.

Screen sets, still another type, imitate the old-fashioned boudoir screen both in height and in method of lighting. These usually consist of several flats, often with two-way hinges so that they may assume any variety of angles. They may be used for impressionistic interiors or any style of exterior. Closely related to the screen set is an-

other type known as the book set. It consists of a post to which flats are hinged like the leaves of a book. These are painted for purely theatrical effect. Of any height, they may be combined with other flats or drapes to take in the whole stage.

Currently, the designer has available a few mechanical devices that aid in the quick change of scenery. The wagon, a low sturdy platform set on rubber-tired casters, is used to transport sets where no fly-system exists. The merry-go-round, or disc stage, moving on casters and pivoted in the center, is another device that is used frequently. The whole disc usually is divided into thirds, and three sets may be erected and rolled into place as required.

Technical Improvements Needed

Any consulting engineer who took the time to familiarize himself with current theater practice would soon find that there is much to be desired from the technical point of view. Producers, directors, stage designers, and all others connected with the theater are primarily artists. It is unfortunately true that far too little attention has been paid to opportunities for technical improvement.

For example, drops generally are made of cloth tacked over a wooden frame. Canvas of either linen or cotton frequently is used. For cheaper drops a heavy grade of muslin is substituted. Drops also are made of translucent materials – netting, gauze or bobbinet, and scrim. These translucent drops permit quick changes from one scene to another. Gauze when painted and lit from the front will display a scene almost as well as canvas, but when the front lights are dimmed and bright lights are brought up in from behind, the gauze becomes transparent and gives a haze to the scene behind it. Then, by just flying the gauze drop up and out of sight, the scene behind becomes clear and sharp.

On these fabrics the scene designer has depended for all his stage effects. But many other materials known to the engineer might better serve the purpose – materials that might be more economical and even lighter in weight.

Better Fireproofing Materials

By law, all materials and even the lumber used in stage work must be fireproofed, and this adds to the cost. Phosphate of ammonia is the basic chemical of which these fireproofing compositions are made, and so far, it has been considered the most efficient of the chemicals available. Yet, there is some doubt as to just how fireproof these treated materials are, and there is always the question of how well they have been treated. This is a problem for the engineer. He might find a better solution in the use of truly fireproof material (glass cloth, perhaps) or there may be more dependable and perhaps cheaper fireproofing chemicals. Glass cloth also is not affected by changes in humidity that give so much trouble by wrinkling and warping canvas.

The scene painter uses tempera colors – pigments mixed with glue as an adhesive. He occa-

Spray-painting "traveler" drop for "Music Man." Broadway and road show scenery was handled by Howard Bay.

sionally uses dyes for special effects. These usually are mixed with the tempera colors. On canvas the dye stains the cloth and even may run. These tempera colors on glass cloth could be washed off with just soap and hot water. In this way a drop from a previous show could be washed and repainted for a new show with substantial savings in the cost of production. Scenery could be salvaged from a show that had failed. Canvas scenery is a total loss. When stock companies were in existence, the old sets could be rented to them after the show had closed on Broadway, and this became an adequate reason for storing the old sets. But stock companies no longer exist and storage space is expensive.

There is another aspect to this problem. In the studio, a scene may appear to be just what the designer wanted. But, under stage lighting, the same set may be a complete washout. The designer can hardly ask the producer to pay for a new scene. If it were glass cloth or other washable material instead of canvas, the drop could be washed and repainted right on the stage under the very lights to be used during the performance.

Canvas Skies?

And now, another problem arises. A cyclorama, or "cyc," is a drop that has been given a cylindrical form curving around the sides and back of the stage and using curved metal pipes to give it a contour. But canvas is sensitive to humidity which causes it to pull and wrinkle. Without a smooth curvature the real illusion of sky is lost. A heavier cotton velour is easier to keep taut and smoother than canvas and often is substituted for it.

In some modern theaters a plaster dome (assuming the shape of the inside surface of a quarter of a sphere) has replaced the "cyc." Its smooth and rigid surface when flooded with diffused light gives a most effective and realistic illusion of infinite space. It requires an enormous stage space in order to permit scene shifting, thus limiting its use to the large theaters.

The engineer can readily see the need for something approaching the quality of the plaster dome yet suited to theaters with smaller stage space. It also might be made transportable for road shows. In Europe, a fairly good substitute was made with a very finely woven linen "cyc" that hung from a specially constructed overhead track which seemed to have the ability to keep the canvas taut without weights at the bottom, thus permitting it to be rolled up like a window shade and out of sight for scene shifting. The mechanics of this overhead track seems to have escaped the American designers. And if the cyclorama could be given the shape of a truncated cone, the approach to the spherical effect would be even greater. Some plastic might be used as a substitute for the fine linen making it easier to keep it taut without weighting the bottom. Aluminum sheeting (say 4-in. wide) folded and fixed over the bottom edge would prevent tearing.

White pine battens similar to those that are used for drops also are used in building the frame of a flat. Here again, the concern of the engineer should be in the substitution of materials or methods of construction. The high cost of man-hours in this particular field makes every moment saved an economy.

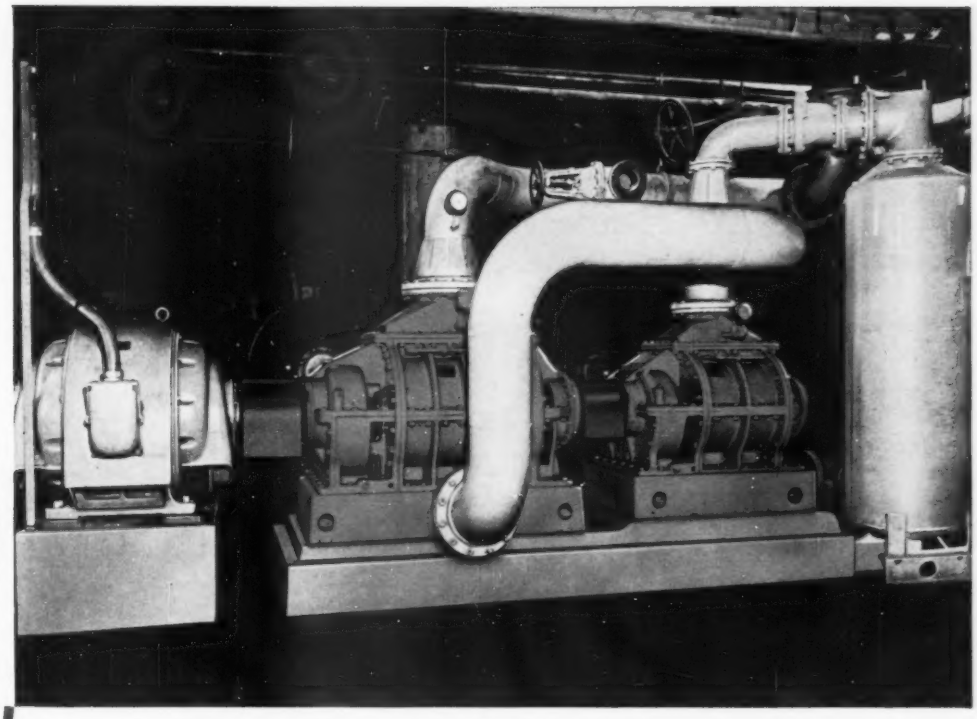
Aluminum Frames for Flats

Now suppose rectangular aluminum piping of the same dimensions as the wooden battens were used, this piping being cut to a module. Ends could be grooved so that they can be fitted tightly into one another, and a frame could be assembled in a short time. The canvas rather than being tacked and glued on the frame could be fastened with rivets or by some other method. There certainly must be many other ways that would occur to the engineer. Grommets or eyelets along the edge of the canvas would permit it to be lashed to the aluminum piping. Then the canvas could be stretched as tightly as the painter pleased.

There are several distinct advantages in using aluminum piping. A frame could be assembled or disassembled in a short time. The frame pieces could be put together to make any size or sort of frame desired. They could be used over and over again. They could be easily crated for transportation. The canvas, too, could be rolled and crated.

The designer today uses solidly built doors, archways, windows, and fireplaces. These must be inserted into the flats. These solid pieces would certainly defeat the advantages gained. Yet we already have aluminum doors and windows in the building trade, and there is no reason why they could not be constructed piecemeal and give just as solid an appearance. Study by the engineer would solve many of these problems.

Perhaps the greatest technical advance in the theater has been in the field of stage lighting. Also, mechanical devices have helped in making possible the raising and lowering of stage levels and the construction of revolving stages for special effects. However, the field is wide open for the consulting engineer who can adjust himself to the peculiarities of the theater and can become, to some extent, a part of it. Mechanical, electrical, structural, and perhaps even chemical engineers, will find there is real opportunity. The stage designer needs the engineer as much or even more than does the architect. ▲▲



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ARTHUR L. SPAET, Slocum & Fuller

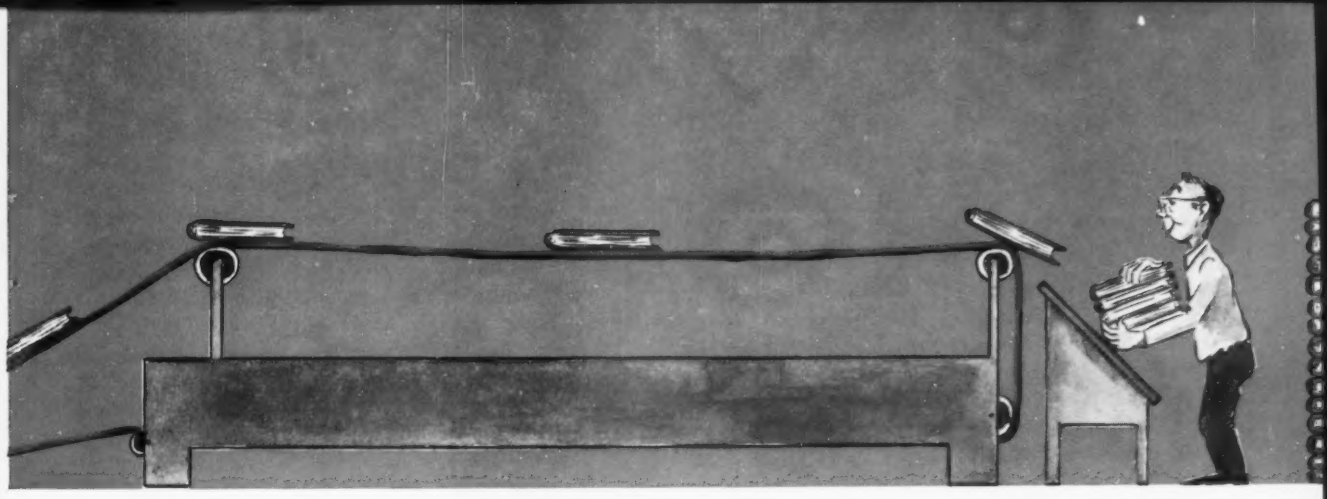
EVERY ENGINEER who writes specifications has considered the possibility of finding standard text matter written to fit every project. It is no secret to anyone in our profession that some sections of every specification represent routine repetitive sentences or paragraphs. Advance preparation of this material is not only possible but highly desirable because the specifications usually must be written after the design has been substantially completed and time is at a premium. Then, there is the pertinent consideration of savings in engineering costs if special handwritten copy can be avoided.

My first experience with the techniques and turmoil of this form of engineering composition occurred during my early work as a designer-draftsman. My board work was followed by preparation of the specifications, and the procedure was cut and paste, patch and Scotch tape, scribble and staple. Gradually, a mess of sheets was assembled from previous specifications with corrections and additions penciled in. If you ran out of applicable old specifications, you were sunk. I believe that something of this sort is standard procedure in most engineering offices.

I was employed at the time in the central engineering department of a women's specialty chain. The limited nature of the engineering design presented an obvious opportunity for standardization of some sections of the paper work. With a certain amount of judicious pruning and copying from the proper sources, it was no great trick to turn out a standard section of plumbing specifications, which thereafter was used for every job — much to my satisfaction and amazement.

Previous Attempts

Later I confirmed my feeling that somebody must have tackled this matter before. I learned that there was available in my field several published samples of specifications, among them the very good volume entitled *Streamlined Specification Standards*, Volume II, by Small and Axelbank (Reinhold), which contained an excellent introduction by Mr. Alfred Jaros, of Jaros, Baum & Bolles. In fact, as early as 1927, a good and complete set of hospital specifications was published by the Pencil Points Press. Other available texts include the volume by Harold Sleeper, *Architectural Specifications* (Wiley), and the *Data Book for Civil Engineers*, Volume II, *Specifications and Costs*, by Elwyn Seelye (Wiley). Structural engineers will be familiar with the AISC *Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings*.



Standard specifications also have been used successfully in utility design. For example, the Consolidated Edison Co. of New York, Inc., has a ready-made specification, *Installation of Steam Service Piping and Equipment on Consumers Premises,* which includes sections on "Installation of Piping," "Standard Equipment," and "General Terms and Conditions." This is used, without revision, for every customer steam service job.

A more recent effort in the direction of time saving is the publication *Special Conditions for Mechanical and Electrical Trades* prepared by the New York Association of Consulting Engineers.

In 1956, I served on a committee headed by Colonel H. Terry, whose purpose was to develop these Special Conditions for the New York Association. These are somewhat like the AIA General Conditions but serve to supplement rather than duplicate them. The New York Association publication concerns itself more with contractual requirements of a general and legal nature than with technical detail.

Difficulties of Standard Specifications

It is a fact, however, that specifications worthy of a consulting engineer must be tailored to the job at hand. They must be prepared carefully for the particular conditions of each project. Use of boiler plate or cut-and-patch procedures apply only to repetitive and identical jobs, and even then they have their disadvantages. Furthermore, on some jobs we are engineering subcontractors to an architect, and we must modify the form and content of our specifications to coordinate with the architect's format and general conditions. In other instances, we are prime engineering contractors dealing directly with the client, and then our specifications must include the general conditions normally written in the architect's office.

My experience has shown that there are technical limitations in the use of standard paragraphs which, in a machine-like sort of way, can be dropped into the specifications hopper for each job. Each of our jobs is a combination of different materials, systems, grades, and qualities of workmanship. For example, heating may be by means of convectors, radiators, cabinet heaters, unit heaters, central warm air, or radiant heating. The source may be district steam, a central boiler plant serving many buildings, or a single local steam unit. The electrical distribution system may be at 115 or 230 volts single phase, 120/208 volts three phase, or 277/480 volts three phase. Thus the number of possible arrangements of elements and components make it impossible to write an all-embracing standard text for our work.

A Different Approach

However, it is in the elements of the system, in the many components and parts, that repetition takes place from job to job, and looked at this way no one would deny the possibility of standardization and the use of specialized and time saving methods.

In many of the larger engineering firms, effective use has been made of a specifications writer, or even of a specifications writing section. As our firm grew in size and the scope of our jobs increased in complexity, we considered the possibility of using a specialist. However, it was the opinion of our senior staff that specifications should be written by the engineer doing the design work, for he and only he is thoroughly familiar with the details of the job.

Therefore, about seven years ago, I set myself the task of developing some simplified methods that would reduce the task of routine text writing, and would let us use the costly time of these top engineers to the best advantage.

As a result, we have developed at Slocum & Fuller a set of worksheets, each of which has been culled carefully from previous specifications, revised in accordance with our experience, fitted to the manufacturers' latest engineering recommenda-

tions, and tempered by our knowledge of actual problems with materials and methods as encountered in the field.

Skepticism at Start

At the start, when this matter was discussed with section chiefs, the general reaction was one of pessimism. "Too complex," "Can't be done," "Too many variables," "Would take too much time" — these were typical comments. They were right in that it did take time: time to prepare, time to correct, time to revise and then revise again, time to instruct our engineers in their use. But the job was done.

Today, the body of each of our specifications is written around these worksheets. Special material is added to supplement the prepared text whenever it is required for completeness and clarity. Each design engineer prepares the Special Conditions and coordinates the various portions, both within our office and between ourselves and the architect's office. Then the sections of the specifications are reviewed and approved by the section chief or a partner.

By use of these worksheets, I believe our design engineers cut at least 75 percent from the time once required to prepare these documents. The worksheets have the further very obvious advantages of providing uniformity of format and phraseology, of providing the typists with more readily legible material as contrasted with handwritten copy, and of assuring a degree of technical correctness, thoroughness, and broadness in detail not normally included by even the better than average design engineer.

The Specification Format

Our format is adapted to the frequent necessity for modifying and changing specifications at the last minute. The client invariably wants some last minute changes. In earlier formats used by our firm, it was frequently necessary to retype extensive sections of the specifications for such a change. Now, by breaking down the specification into a series of elements, we require a minimum of retyping and revision when a change or an addition becomes necessary.

A typical specification will consist of three sections; these are preceded by a set of Special Conditions applicable to all sections. The titles of these sections are:

¶ Special Conditions for Mechanical and Electrical Trades
¶ Plumbing and Drainage
¶ Heating, Ventilating, and Air Conditioning
¶ Electrical Light and Power Distribution

These sections usually are referred to among our staff by the short titles of: Special Conditions, Plumbing, Heating, and Electric.

Each trade section is divided into two subsections, with the pages of each subsection numbered independently. The subsections cover: (1) Systems and Works, and (2) Materials and Workmanship. On certain jobs we add sections such as "Sprinklers," "Hydraulic Lift," or "Water Storage Tower."

"Systems and Works," the first subsection in each section, covers a series of general directives to the contractor regarding the various systems and major items of work included in the project, a brief description of each system, and a description of any major one-of-a-kind items. A typical major one-of-a-kind speciality included in this subsection could be a large centrifugal refrigeration compressor, or an emergency electric generator plant.

Under "Materials and Workmanship" we normally include description of those materials that go into the construction in multiple, items such as pipe, fittings, wire and conduit, convectors, and lighting fixtures. We also include descriptions of installation procedures for these multiple items as well as specifications for joints and splices. If at the last minute the architect decides to modify the vestibule, and we decide that it is necessary to include a vestibule cabinet type unit heater, this can be added at the end of the "Materials" section, without substantial alteration to the body of the specification even though no such unit heater was mentioned before. In addition, a brief descriptive passage may be added under "Systems and Works" if any clarification of intent is necessary.

Mechanics of the Method

The mechanics of preparing the copy are simple. There is a master office set of specifications worksheets for all trades and for the Special Conditions. These are typed on onion skin paper with a nonsmudge carbon paper imprint on the back so that they will reproduce clearly.

From these office master sheets, copies have been made in the form of sepia transparencies. Our practice is to give to each section chief a set of sepia masters of the Special Conditions, and a set of sepia masters of his particular field of engineering activity. These sepias are kept in 3-ring, loose-leaf, 8½-in. by 11-in. binders in each section.

At the time of writing his specification, the design engineer selects the appropriate worksheets, has them removed from the loose-leaf binder, and has them sent to the blueprinter for a set of blueline paper prints. The sepia transparencies then are returned unmarked to the loose-leaf binder. In this manner the transparencies are used over and over.

Each designer then writes his section of the specifications by marking up the paper print work-

sheets in accordance with the requirements of the particular job. Typed final copy is prepared from the paper worksheets, and several yellow copies of these are issued to the design staff for coordination and correction. The final office typed copy or stencil always remains with the typist. The yellow copies subsequently are returned to the typist with corrections. A sample of a marked-up worksheet is illustrated at the bottom of this column.

Keeping Up to Date

Our standard worksheets are by no means static. They change to some degree from day to day. They are continually in the process of revision as our thinking and experience becomes more refined, and as new techniques and products are brought on the market. Some of the worksheets have been revised as many as ten times. Approximately once a month the clerical section chief takes the sepia sheet loose-leaf binders and brings them up to date in accordance with any corrections that have been made in the office master set.

In preparing and revising the worksheets, it is our practice to review them with manufacturers' representives where a major manufacturer's specialty item is included. For example, our sheets on Automatic Combustion Controls, and the paragraphs on Automatic Temperature Controls were reviewed with several manufacturers' representatives to make sure that the text was technically correct and fair to the various manufacturers whose products we listed as acceptable.

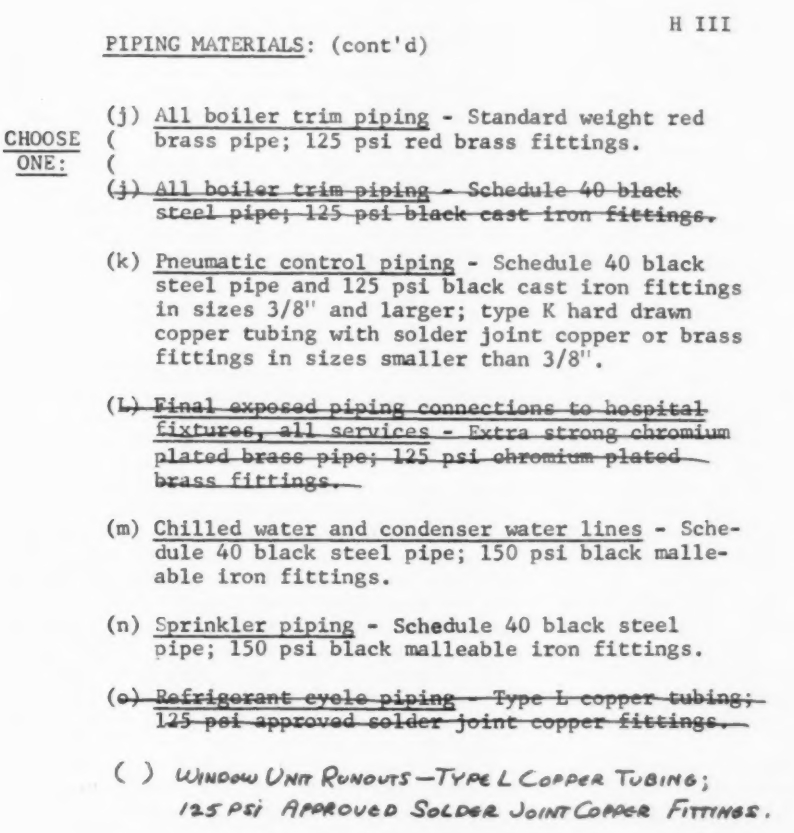
Occasionally manufacturers' representatives will point out that some of our worksheets are more elaborate and detailed than necessary for specification purposes. Our reason for the inclusion of detail is that the worksheets also serve as a guide for the design engineer. Any material not necessary for bidding or specification purposes subsequently is eliminated from the text as given the typist.

Goals to be Met

My philosophy with regard to specifications is that they must be fully detailed, they must protect the owner, and they must be fair to the contractors.

On occasion I have had requests from clients to keep our specifications short and brief, the implication being that the engineer frequently tends to load his specification with superfluous material. I cannot take issue with the request to eliminate superfluous material, especially the vague "as required" and "all necessary" clauses and similar ambiguous blanket phrases. However, I do believe that a specification should be as detailed and as well spelled out as the over-all job conditions warrant. The more information the contractor is given, the better a job he will be able to do.

It is not Slocum & Fuller's policy to attempt to make the contractor responsible for features of the design normally within the consulting engineer's scope, and we do not want to stick the contractor with the responsibility for any portions of the installation on which design information is vague, incomplete, or unavailable. While it is impossible to foresee every eventuality, we always make a real effort



H III

PIPING MATERIALS: (cont'd)

(j) All boiler trim piping - Standard weight red brass pipe; 125 psi red brass fittings.

CHOOSE ONE: (

(~~j~~) ~~All boiler trim piping - Schedule 40 black steel pipe; 125 psi black cast iron fittings.~~

(k) Pneumatic control piping - Schedule 40 black steel pipe and 125 psi black cast iron fittings in sizes 3/8" and larger; type K hard drawn copper tubing with solder joint copper or brass fittings in sizes smaller than 3/8".

(~~L~~) ~~Final exposed piping connections to hospital fixtures, all services - Extra strong chromium plated brass pipe; 125 psi chromium plated brass fittings.~~

(m) Chilled water and condenser water lines - Schedule 40 black steel pipe; 150 psi black malleable iron fittings.

(n) Sprinkler piping - Schedule 40 black steel pipe; 150 psi black malleable iron fittings.

(~~o~~) ~~Refrigerant cycle piping - Type L copper tubing; 125 psi approved solder joint copper fittings.~~

( ) WINDOW UNIT RUNOUTS—TYPE L COPPER TUBING; 125 PSI APPROVED SOLDER JOINT COPPER FITTINGS.

( ) ALL WORKING PRESSURES REFER TO STEAM PRESSURE.

to define the scope of the contractor's work so completely that he is not forced to include items he did not figure on.

My further belief is that the contractor should make a profit on every job. If during the course of construction he is required to furnish some substantial item of work or equipment not clearly included in the plans and specifications he should be paid for it. If the nature of the plans and specifications are such that he is caught with the responsibility or requirement to perform unforeseen or improperly defined items of work, he will battle vigorously for an extra. If extras are arbitrarily ruled out, he will somehow take it out of the job. Both the owner and the engineering will suffer.

Every specification must be carefully hand-tailored to the job. Any material included in a specification that is not applicable to the specific project is likely to confuse the estimator. It probably will cause delay and confusion in the contractor's prep-

Instructions For Designers On How To Use

1. Specifications are complementary to the drawings. Together they serve to indicate engineering intent; they serve as a basis for estimating by the bidding contractors; and finally they define the contractor's obligation and scope of work when the contract is let.

2. It is our practice to put information in either the specification or on the drawings, but not in both places. The choice is based on the consideration of where the information does the most good. For example, field details of direct concern to the mechanics obviously belong on the drawings. Descriptions of complex items of equipment such as an emergency generator or a refrigeration machine should go into the specification, where the contractor's purchasing agent can readily find them.

3. If, in the interests of clarity, it seems desirable to note an item in both places, do so. In general, however, use one or the other, but not both.

4. Our worksheets are not "standard" specifications. They are worksheets, and cannot be used verbatim. Their use requires discretion and careful thought.

5. Read and edit and modify each page in detail.

6. Spaces between words, or the word "Choose" in the margin, indicate that a selection must be made or a dimension or similar item filled in.

7. An effort has been made in these sheets to coordinate between trades. However, call to the attention of the other designers any item which concerns other trades.

8. A full set of specifications involves complete coordination between:
(a) Architectural General Conditions (by Architect)
(b) Architectural Special Conditions (by Architect)
(c) Architectural and Structural Trades (by Architect)
(d) Laboratory, Kitchen, and Shop Equipment (by the Architect and by Slocum & Fuller)
(e) Special Conditions for Mechanical and Electrical Trades (by Slocum & Fuller)
(f) Plumbing, Heating, Ventilating, Air Conditioning, and Electric Sections (by Slocum & Fuller)
(g) Any other Mechanical or Electrical Work, such as pneumatic tubes, elevator, hydraulic lift, sprinklers, or water storage tower (by Slocum & Fuller)

9. Coordination of the several parts of the specifications is the responsibility of the Project Engineer.

10. Obtain a copy of the Architect's General Conditions and Supplementary Conditions for the project. Review these in detail. Check for any possible conflict with ours. Be sure to avoid duplication.

11. There are two parties to any construction contract: (a) The Owner as represented by the Architect or by the Clerk of the Works; and (b) The Contractor. Therefore, all references to any party to the contract should be either to "The Owner," or to "The Contractor."

12. In certain special instances, you may make reference to the various subcontractors by their specialty trades, as the Plumbing Contractor, or the Heating and Air Conditioning Contractor. Do not hesitate to use the titles of the subcontractors where this is in the interest of clarity. However, use this only where it does clarify. Otherwise, refer to "The Contractor." For example, from the HVAC Section on Automatic Temperature Controls: "Automatic valves and dampers shall be installed by the Air Conditioning Contractor. All pneumatic control piping shall be installed by the Temperature Control Subcontractor."

13. It is our practice to make cross-reference in the specifications by means of a subparagraph worded as follows: "Refer to the following paragraphs for related work." In such cross-reference, refer to the section or paragraph by its title only. Do not use paragraph or page numbers or letters for cross-reference. Note how the following are phrased:
From the HVAC Section on Boilers and Boiler Accessories: "A valved city water make-up line will be brought to within ten feet of each boiler under the Plumbing Section of the work. Connect to same."
From the Electrical Section on Special Circuits: "The oil burners, induced draft fan, and automatic combustion controls will be furnished and wired under the Heating Section of the work. Connect to the line side only of the combustion control panel."

aration of his proposal and may result in increased safety factors in his bid price. Therefore, every effort is made to weed out from the worksheets items not included in the particular job.

Base Specifications

In recent years much attention has been given to the question of writing closed or base specifications, rather than completely open or "approved equal" specifications. Both schemes have their place and both are used in our specifications, depending upon the nature of the project.

If the particular project is one in which we prefer to exercise rigid and tight control, with minimum variation from our design, we will make use of the base specification form. If the job is one we wish to have bid as inexpensively as possible, with first cost as a paramount consideration, we will be inclined to the use of the open specification, thereby permitting the contractor to make every possible

Slocum & Fuller Specification Worksheets

14. Do not use "etc.," or "as necessary," or "as required," or similar catch-all expressions. These terms are too indefinite for bidding and inspection purposes and invariably defeat the intended purpose.

15. Where items are furnished under other contracts, do not use the expression "by others" if you can avoid it. Refer instead to a particular trade or section, e.g., "Wiring will be furnished and installed under the Electrical Section of the work." Or "Pantry equipment will be furnished by the Owner."

16. The use of the expression "as indicated on the drawings," or "as shown," is unnecessary. The fact that a detail is on the drawings makes it unnecessary to mention it in the specifications.

17. Do not use the expressions "or equal," or "approved equal," or similar terms. Every item should be "as approved."

18. Do not place upon the contractor the responsibility for inspecting and determining hidden or indefinite job conditions. If you cannot clarify the details or scope, how can he?

19. Keep the text clear; avoid words or phrases having varied or indefinite or ambiguous meanings. Spell out and explain your intent clearly and in full detail. Make your requirements explicit.
(a) Do not confuse "either" and "both," e.g., "Ducts shall be painted on either side," should read, "Paint ducts on both sides." Either implies a choice.
(b) Never use the expression "and/or;" do not confuse "or" and "and;" in general, use "and." For example, "Provide labor cost for temporary heat or for testing" should read " . . . temporary heat and for testing."
(c) Do not say: "The equipment shall be removed and replaced," since the contractor may assume new materials are intended, and increase his bid price accordingly. Instead say: "Remove the equipment from the building and store safely, during alterations; reinstall the same equipment after completion of the alterations."
(d) Do not say: "The water piping shall be replaced." This can imply reinstallation of the old materials, which is not intended in this case. Instead say, "Disconnect and replace existing water piping with new materials."
(e) Where any special item of work is called for, make certain to specify all incidental materials. For example, if you specify, "Remove existing furnace refractory brick and replace with new brick," give a specification for the quality of the replacement brick. If, in addition, the asbestos wallboard liner and floor hollow tile must be replaced, spell this out.

20. *Use of Abbreviations and Symbols.* In general, avoid the use of abbreviations and symbols, except where they are positively understood, accepted, and can be used economically. For example, psi, cfm, ft, kw. The use of ″hg, #/hr, °F, is not recommended.
The use of symbols is undesirable for three reasons: (a) some are difficult to reproduce on typewriter and stencil; (b) they frequently have more than one meaning; (c) the typist may not know what is intended. Write out in full: inches of mercury, pounds per hour, degrees F, and any other term about which there may be the least doubt.

21. *Numbers.* In general, spell out numbers from zero to twelve inclusive. Use numerals from 13 on.
Do not use both the written and numeral figure: i.e., "ten (10)."

22. *Avoid the expression "The Contractor shall furnish and install . . . "* Say, "Furnish and install . . . " In general, start with a verb whenever possible. Do not say, "The contractor shall make all tests," say instead, "Make all tests." As a further example, "The Contractor shall operate and maintain the temporary heating system," should read, "Operate and maintain the temporary heating system."

23. *Shall vs. Will.* Use "shall" whenever you require the contractor to do something or describe something he must furnish. "Will" is used to inform, or to tell him something, or to indicate a future requirement, e.g., "Current for testing will be paid for by the Owner." In general, avoid the use of "shall" whenever the grammar permits, as described in 22 above.

24. Our worksheets are not "standard" specifications. They are worksheets. Read, edit, and modify each page in detail.

saving in the purchase of his materials. Never, however, will we accept substandard makes of equipment or items of unknown manufacture. In the event the contractor desires to use a make unknown to us, we will check it in detail before accepting it.

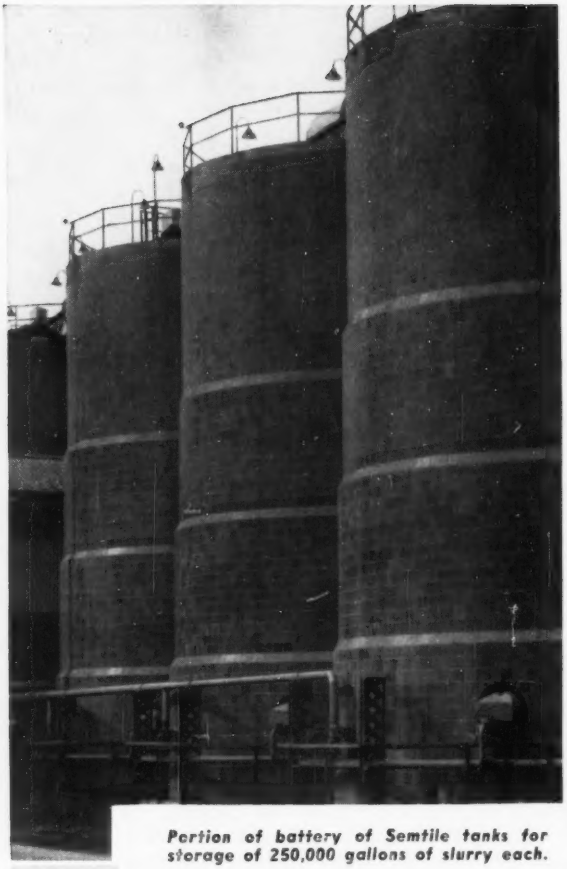
As a result of one or two awkward experiences in the past, where the contractor chose to take the stand that it was our responsibility to prove his proposed item was not the equal of that specified, we have dropped this phraseology "or equal" or "or approved equal" from our specifications. While it still exists in some of our old worksheets, it is slowly being deleted in favor of the wording "as approved." Our intent is to eliminate any doubt regarding our control of the job.

Training Required

In addition to training our designers and engineers in the use of our specifications worksheets, we have found it of value to explain to the chief of our clerical section some of the principles and the problems of preparing specifications. Her knowledge and understanding of the general over-all principles has been invaluable. Our experience has been that our typists, under the chief's guidance, can do a commendable job of editing the specifications as they type them. Our clerical section chief is in complete control of the format, coordinates all clerical details with the client's office, and modifies the format of the text where the designer or engineer has set it up improperly. This results in coordinating the appearance of the specifications as well as coordinating the contents, since the several designers work independently of each other and do not always use exactly the same style.

The existence of our worksheets would seem to make specification writing a snap, and put it in the do-it-yourself category. This is not actually true. A specification is a highly technical document involving detailed knowledge of several trades and coordination between the trades, knowledge of techniques of civil, industrial, and commercial construction, trade union rulings, all sorts of applicable codes, as well as some understanding of the legal and contractual obligations on the part of all parties. Therefore, it is my opinion that a specification will only be as good as the experience and intelligence of the design engineer who prepares it. Just as possession of a business management handbook does not make an executive, possession of the worksheets does not automatically confer upon our designers the ability to write a good specification. There is still no substitute for training, education, and experience.

In keeping with our emphasis on training and instruction of our staff, the set of notes on pages 104-5 is issued to each designer as a guide. ▲▲



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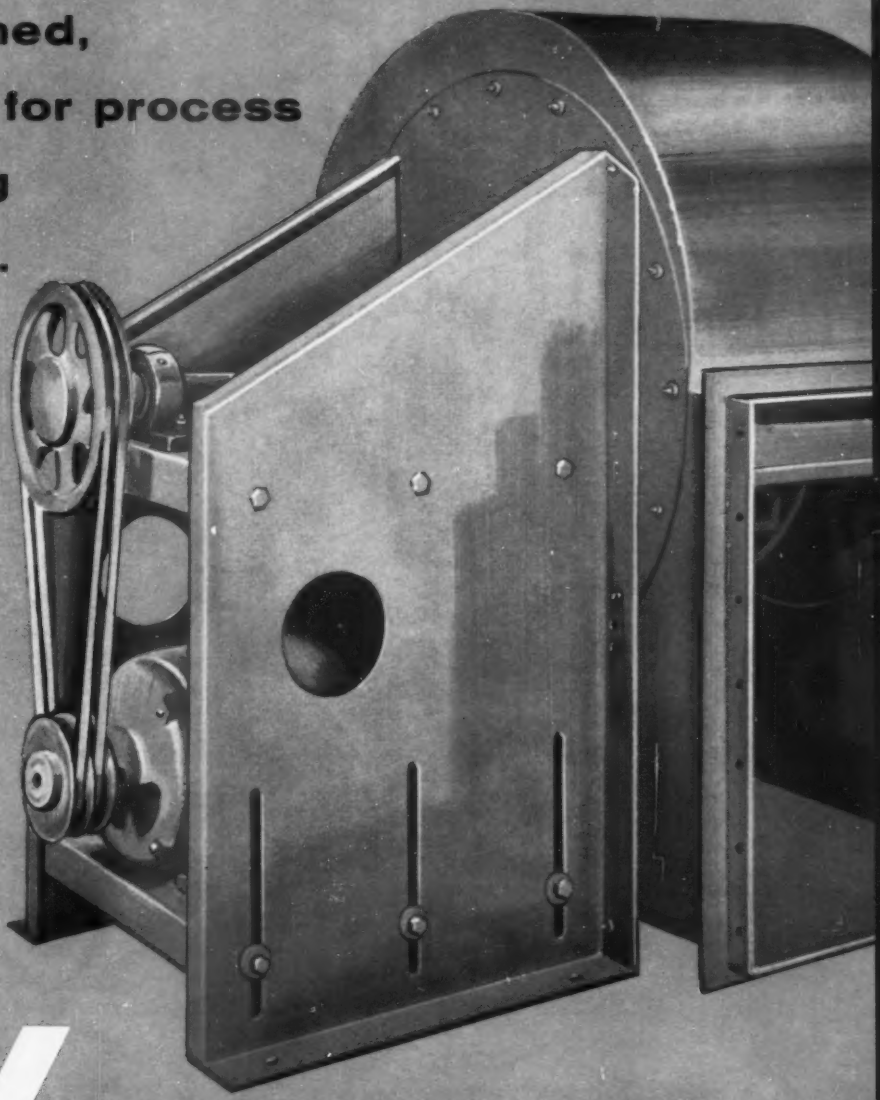

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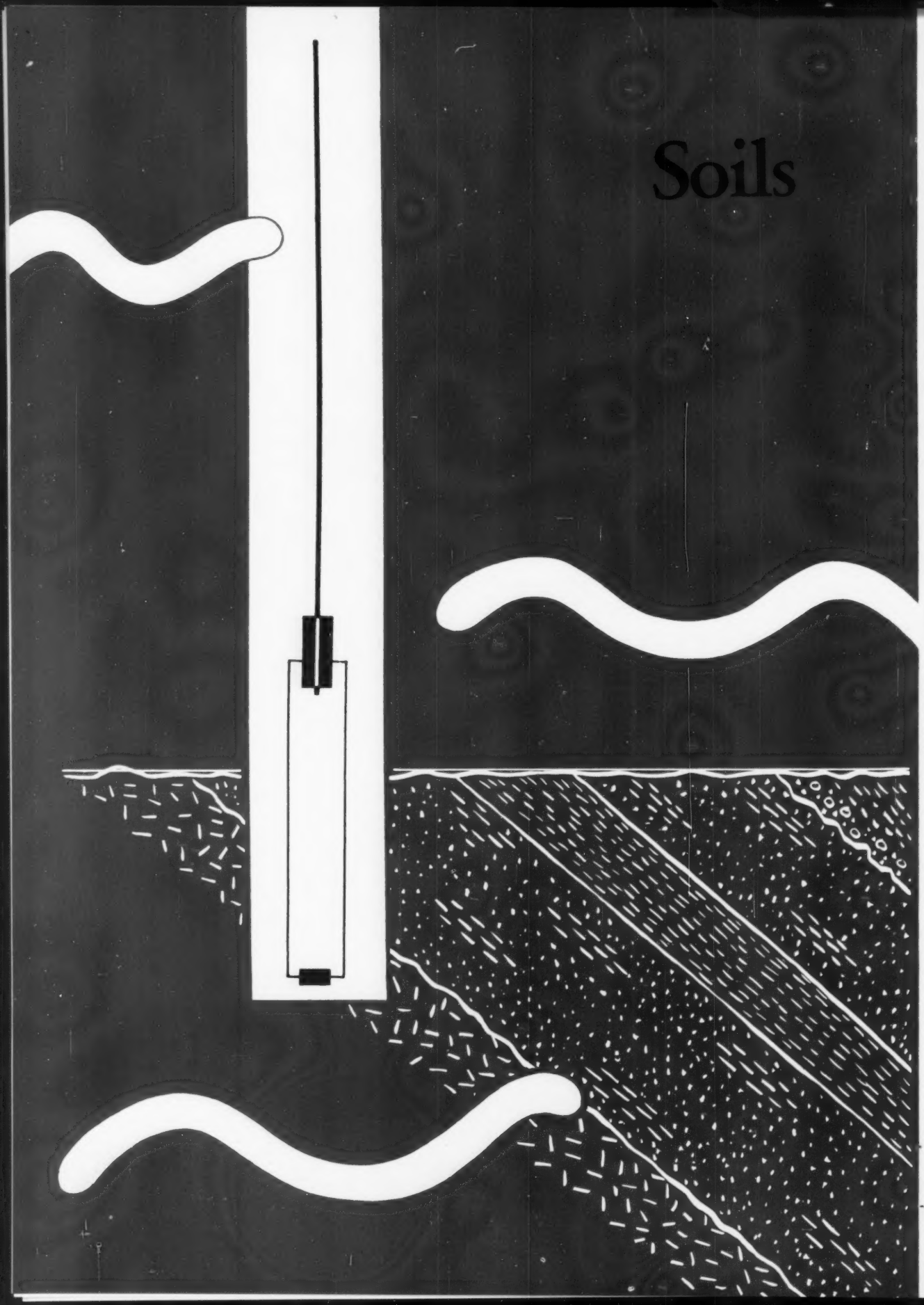
Soils



Engineering...

Its Role in the Interstate Highway Program

DAVID M. GREER, President, Greer Engineering Associates, Inc.

BY NO MEANS all of the consulting engineering firms engaged in design on current interstate highway projects are veterans in highway work. Before the turnpike construction program of 1949-1955, relatively few private engineering firms were engaged in highway design. And before this, nearly all highways in the United States were designed by state highway departments. In most states consulting firms rarely were called in except to solve special problems. During the turnpike period, however, dozens of engineering firms, large and small, were drawn into the highway design field; and in the present interstate program many more are being used.

To most of the firms new in the field, soils engineering is the least familiar phase of the work that they are asked to undertake. Some firms try to handle this phase by hiring a soils engineer. Some establish, equip, and staff a soils laboratory. Some engage an outside consulting soils engineering firm.

There are no uniform standards defining just how much soils engineering work must be done as part of the design of a section of highway. Further, there is no uniform practice among various states to establish which soils engineering functions are a normal part of the consulting engineer's work, to be paid for as part of his regular fee, and which functions may be treated and paid for as extras.

Very good arguments support the view that all soils engineering functions should be considered outside the scope of the highway consultant's regular duties and either should be furnished to him by the highway department or be classed as extras and paid for as such. An important basis for this contention is the fact that soils engineering, as required by modern highway engineering contracts, is a relatively recent innovation; it includes much engineering work that formerly was not required of the consulting firm (or often was not done at all), but which is now generally recognized as essential to highway design. These duties have been added without, in most instances, any compensating increase in the consultant's fee.

The exact scope of the work to be done, as well as the division of it between the regular duties of the consultant and extras which are separately reimbursable to him, is determined by local (state highway department) policy and practice, and approved by the U.S. Bureau of Public Roads. There is no governing standard or specification by the Bureau of Public Roads, however, that is used to bring about uniform design procedures among the various states.

Preparation of Roadway Soil Profiles

The preparation of roadway soil profile drawings, giving the identification and character of subgrade soils and their distribution and the ground-water conditions that will affect their behavior, is a basic step in roadway design. These nearly always are required as part of the contract drawings. Soils profiles provide the designer most of the data he will need for detailed design of pavement, base, and subgrade; they provide the prospective contractor an accurate picture of the conditions and materials he will have to work with; and they furnish the state a permanent and detailed record that will be indispensable for planning maintenance.

The steps involved in preparation of soils profiles can be outlined as follows:

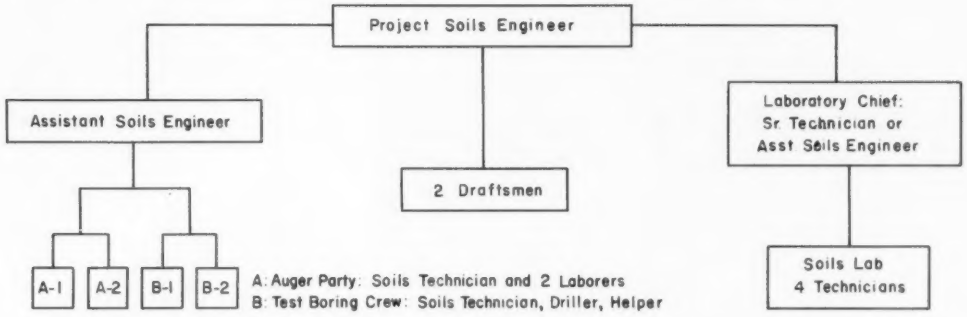
Field Work

Auger borings and test pits

In-place density tests and plate bearing tests, where needed

Rig borings for deep cut sections and areas of rock cut

Ground reconnaissance for topographic and



Organization chart shows staff needed to complete soils work on typical 20-mile length of road.

geological correlation of soil conditions with design requirements

Laboratory Tests

Identification tests on typical samples and possibly on all samples if soils are borderline in classification

Moisture content determinations on all samples of cohesive soils

Compaction (optimum moisture) tests on typical samples covering the entire range of materials that will have to be moved and re-compacted

Office Engineering

Assembly of data, tabulation and correlation of laboratory test results, and preparation of laboratory logs for borings and test pits

Drafting of soil profile sheets

Roadway Design Analysis

A number of design decisions, affecting both the contract drawings and the written specifications, will be made from the soils profiles. These determinations should be made by the soils engineer, who will have the soil conditions well in mind after his work on the soils profiles, rather than by another engineer less familiar with the soil conditions. This phase of the work should be presented in a roadway design analysis report, which will make recommendations for:

¶ Pavement design variations as dictated by soil and ground-water conditions

¶ Subgrade protection against frost action and pumping

¶ Foundation stability and control of settlement under embankment load

¶ Slope stability in cut and fill

¶ Construction practices in embankment placement

Specific recommendations from this report then are incorporated in the drawings and specifications by the highway consultant.

In addition to the work necessary to produce the soils profile, certain supplementary, specialized data are sometimes needed to provide specific design information. The work necessary to produce these data may include:

¶ Carefully supervised rig borings to produce undisturbed samples in areas of weak or compressible soils that must carry high fills or be subject to deep cuts to meet job requirements

¶ Laboratory tests on undisturbed samples from these areas

¶ Determination of climatic data

The extent of this work often is not evident until the work on the soils profile is well under way.

Structure Foundation Reports

For each highway structure, from the smallest to the largest, a structure foundation report is prepared by the project soils engineer. This presents all of the data from field and laboratory; recommends type of foundation, depth, and allowable unit bearing pressures; and gives estimates of settlements and recommended construction practices. The work performed to produce these reports is:

Field Work

Supervision of the test borings

Field soil testing – bearing tests, pile tests, in-place vane shear

Laboratory Work

Laboratory classification of all samples

Strength tests on selected undisturbed foundation samples

Consolidation tests on selected undisturbed foundation samples

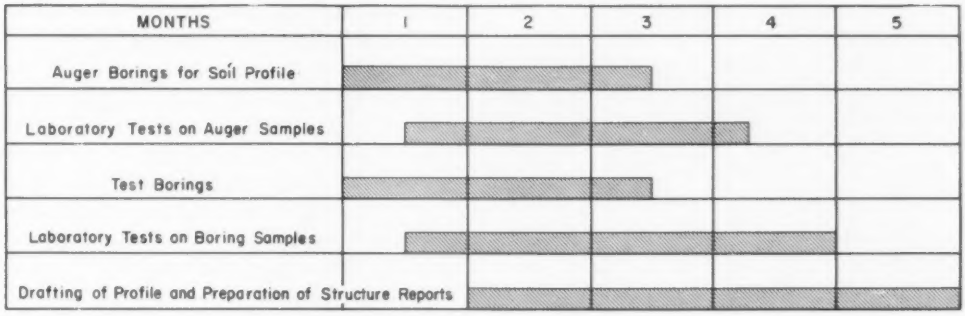
Identification and moisture content tests on selected samples to confirm classification and to extend the usefulness of the strength and consolidation tests

Office Engineering

Assignment of tests and supervision of the testing program

Preparation of the foundation profiles or cross sections required

Foundation analysis for each structure, including determination of recommended foundation type



Feasible progress schedule for soils work on a 20-mile length of road in gently rolling country.

and depth, computation of safe unit loadings for foundation elements, and estimates of settlement

Organization of the Work

As soon as the structure locations have been decided upon and their general type has been determined, test borings are started. It is the job of the project soils engineer to decide where to bore and what type of sampling to require; how deep to take each boring; and what additional borings should be made when unfavorable or anomalous foundation conditions are encountered. Many of these decisions should be made in the field, and they require not only a knowledge of the foundation conditions that the borings have revealed but also an understanding of the nature of the proposed structure and the kind of foundation it must have.

This is not a task for a driller; it is a job for a competent soils and foundations engineer. For example, on a recent project the consulting engineer had a contract for design of approximately 30 miles of interstate highway. There were 35 double structures involved. At the time the consulting soils engineer was called in, test borings had been made by a contract driller, and the samples sent to a commercial laboratory and tested. The soils engineer was asked to review the borings and tests and to prepare a structure foundation report for each of the structures involved.

Possible Pitfalls

A review of the data showed that the number of borings was inadequate (four borings had been made for a double structure involving six piers and four abutments). The borings had been stopped before reaching strong and incompressible soil. There were no undisturbed samples and hence no tests had been conducted suitable for computing bearing capacity or for estimating settlement. The field logs were of questionable value. One stratum, for instance, was described on several logs as "oriental peat;" and all stratum changes occurred at even 5-ft intervals – a very accommodating geologic arrangement.

The soils engineer arranged for the drilling contractor to come back and make two additional borings at each structure, using 3-in. Shelby tube samples in weak and compressible soils. He assigned shear, consolidation, and classification tests; reviewed the testing schedule, techniques, and equipment at the commercial laboratory that had the testing contract; and then assembled the data, and wrote the reports. Because of the press for time, the data used were less than desirable.

The end result was, however, a set of foundation designs which were safe, though somewhat less economical than could have been achieved with better soils data available. The designs were adequately documented and accepted by the state.

Project Soils Engineer's Responsibilities

This example points up the importance of having laboratory tests on the samples from the structure borings under the direction of the project soils engineer; for soil testing techniques often need to be varied according to the conditions that are encountered when the test specimens are being prepared. He also knows the stress distribution to be produced by the structure and the structure's tolerance for settlements. He should set up the minimum testing program needed for the project.

The soils engineer should supervise these various operations, keep them moving smoothly and without lost time, see that there are no gaps in the information collected, and finally, present the results in a clear and usable report. This is obviously not a one-man job. There must be not only a project soils engineer, but, at various times, boring inspectors, auger parties, laboratory soils technicians, draftsmen, and laborers. An organization chart, showing the staff needed for completion of the soils work on a typical 20-mile length of roadway (to interstate standards), is illustrated. Note that this calls for a total of 21 people. Of these, the drill-

ers and helpers usually are employees of a separate drilling contractor.

A feasible progress schedule, based on an assumed 20-mile length of road in gently rolling country, with about one structure per mile, one major stream crossing, and fairly uniform soil conditions, also is illustrated. The initial laboratory staff of four technicians is augmented, as the field work is completed, by the technicians from the auger and test boring parties. The assistant soils engineer helps with drafting, computations, preparation of data, and report preparation. The entire 13-man crew (excluding the drillers, helpers, and laborers) is kept busy until the job is completed.

The end result of this soils engineering work would be approximately 90 soil profile sheets, 1 roadway design analysis report, 20 structure reports, and 7 culvert reports. These would be delivered to the highway consultant progressively, the first soil profile sheets and structure reports being delivered about the end of the third month and the last at the end of the fifth month.

Role of the Soils Engineer

To accomplish this soils engineering work, the highway consultant has two alternatives.

¶ He can furnish from his own staff the project soils engineer, the assistant soils engineers, the auger crews, the soils technicians or boring inspectors, and the draftsmen. Samples obtained then can be sent to a commercial soils laboratory for the tests.

¶ He can engage a consulting soils engineering firm to do the entire job.

If he chooses the first alternative, the highway consultant must employ or already have in his employ a competent project soils engineer. This man must know soils engineering in its field, laboratory, and design phases; he must have experience in highway engineering; and he must be an organizer. Most emphatically, this is not a place for a soils technician, a junior geologist, or a soils-engineer-by-appointment. It is a place where mistakes will be costly to the taxpayer and may be disastrous to the consultant.

The consultant then must select the boring inspectors and the technicians for the auger parties. Soils technicians are not usually easy to find. Thus, these jobs sometimes are filled by inexperienced people who require constant supervision.

Finally, he must select a testing laboratory that is competent, and that is near enough to permit his soils engineer to exercise personal supervision over the testing program.

If the highway consultant selects the second alternative, that of engaging a consulting soils engineering firm to take the entire responsibility, he should be careful in his selection. He must choose a firm that has a qualified staff, the necessary equipment, and plenty of experience. He should be as thorough in his investigation of the soils engineer as his own clients are in employing him.

There are at least two dozen reputable consulting soils and foundation engineering organizations in the United States, varying in size from two or three men to quite sizeable organizations, headed and staffed by men who have the specialized training and experience to qualify them as soils and foundation engineers. These organizations work differently. Some of them do all of the work needed, including the test borings, with their own forces and equipment. Some do the engineering and laboratory work and contract the borings to a drilling contractor. Some have the testing as well as the borings done by outside concerns.

In my opinion there are obvious advantages to the client in having all phases of the work done by one soils engineering organization. This should provide better coordination of the work and faster completion of reports. It makes little difference in the quality of the results whether the borings actually are performed by the consulting soils engineer or are contracted out and carefully supervised by him. But the procedure of preparing specifications, calling for bids, and letting a boring contract delays completion of the soils foundations report.

Whenever the consulting soils engineer has to depend upon an outside laboratory for soil tests, however, the quality, even the validity, of his work depends upon his being in a position to control the testing program in detail. Unlike steel and concrete, soils do not lend themselves conveniently to routine testing by standard test methods. Not only do the tests that should be performed vary with the circumstances under which the soils are to be used or loaded, they also vary according to the type and condition of the soil.

Test Knowledge Vital

It is necessary that the person who assigns the tests know both the soil conditions and the problem to be solved. This person should be available for making decisions as to selection of testing techniques as the tests progress and as the samples are opened and examined. Both the correct classification of soils and the selection of a useful program of tests are matters requiring application of engineering training and judgment. Therefore, close liaison between the project soils engineer and the laboratory is imperative.

Soils testing is classed as professional work by many public bodies and normally is considered with the engineering time in negotiating a contract for the soils engineering work. This is as it should be. The letting of a soils testing contract by com-

petitive bidding is almost certain to produce inferior work which results in overdesign and unnecessary construction expense.

Excellent arguments support the opinion that test borings, performed under engineering supervision, constitute a professional service which should be engaged on a negotiated basis. Certainly the parallel with surveying is very close. It is no more logical to insist that the actual operation of the drilling machine be classed as a contracting operation and be purchased by competitive bidding than it would be to insist that all of a survey crew's operations except the time of the party chief be considered a contracting operation and be purchased by accepting the lowest bid. Test borings are not construction. They are subsurface surveying. Their cost is so small, compared to the importance of the decisions that are based on them and to the sums of money that will have to be spent on overdesign if boring logs and samples are inferior, that the best borings that can be obtained will be the most economical.

Preferred Arrangement

Our feeling is that the best arrangement is one which permits the consulting soils engineer to negotiate an agreement under which he furnishes the entire service, including the test borings, as a professional service. He then can use a boring organization of his own choice, and he alone is responsible to the owner or consultant who engages him for the correctness and adequacy of the final data.

In dealing with public bodies, however, the consulting soils engineer very often must work under the handicap of a long-established practice of buying the cheapest borings obtainable, apparently on the supposition that the end results of boring and sampling operations are not important.

That is a very expensive policy to follow. In contrast to that attitude, we feel that the consulting soils engineering organization should be headed and staffed by competent specialists in soils and foundation engineering; it should have, available and convenient, a professional soil testing laboratory; and it should be permitted to furnish or obtain test borings, to its own specifications, on a negotiated-contract basis.

In a few of the states, these conditions are met in the arrangements set up to permit the consulting engineer to subcontract soils engineering services. In other states, where purchasing department customs or regulations decree that test borings or soil tests cannot be paid for as professional services, the consulting soils engineer still can furnish vital assistance to the design engineer by furnishing him with the best soils design data obtainable under the circumstances. ▲▲

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This is the Way Consulting Engineers Serve Public Clients

CONSULTING ENGINEER
STAFF REPORT

A REPORT FROM THE COMMITTEE OF ONE-HUNDRED. Are there good reasons why a public client should engage a consulting engineer instead of expanding its own engineering department? Can some work best be done by consultants, and some best by government engineers? How can the consulting engineer reach the proper person in government with his sales story, and show it is to the official's advantage to use an outside consultant?

These and other questions we put to our Committee of One-Hundred. Their answers pinpoint the problems in this field of practice and provide excellent reasons why public clients are better off using consultants instead of hiring more engineers.

The Committee of One-Hundred is made up of prominent engineers from all parts of the country. They represent all sizes of firms and fields of specialization. This report is a composite of their thinking. It is not the opinion of any one man on the Committee, but all of them will agree with most of it and most will agree with all.

CE exclusive

THE CONSULTING ENGINEER whose clients are primarily governments – Federal, state, or local – usually has a much more difficult job trying to sell his profession, his firm, and himself than does the consulting engineer who deals primarily with private clients. When a consulting engineer tries to sell a private client, he is dealing with a man who is in business to make a profit, and this client, strongly motivated by his desire to make money, is always open to good suggestions that will help him save his firm's money.

The public client, on the other hand, conscientious as he may be, does not have this profit motive. Instead, under our political and civil service system, there is the tendency for the heads of government engineering departments to be far more interested in building the size of their departments than in finding the most economical or efficient approach to each project. The reason for this is that government employees have learned that a department head all too often is judged (and paid) by how many men he has working under him rather than by how well he does his job. The way to get a higher salary and more power is to enlarge the department. The only loser is the taxpayer.

Bureaucracy the Big Problem

This is the foremost problem facing the consulting engineer who tries to sell his services to a government agency. It is hard to overcome this, for the consulting engineer never should miss an opportunity to urge the upgrading of public engineers. Instead, he should try to show the government department head that his own position is enhanced and his own salary could be increased by establishing his department so that it had a few high-priced men rather than numerous technicians.

According to the Committee of One-Hundred, a good consulting engineer can handle a typical proj-

ect for one-third or one-fourth of the cost of handling it through a public engineering group. But this is extremely hard to prove. The engineer in private practice takes a project at somewhere between 5 and 8 percent of the construction cost if he is operating under an accepted minimum fee schedule. He knows that this is far less than the cost would be when handled by government employee engineers, but published figures on government engineering run as low as 3 to 5 percent of total cost.

Costs of Government Engineering

Government clients can lower their cost figures by adroit juggling and questionable accounting practices. Consulting engineers who have worked for governments insist that when overhead, taxes, insurance, travel expenses, utility cost, equipment, furniture, fixtures, and fringe benefits are taken into account, the cost of government engineering should be more realistically placed at 20 to 30 percent of project cost. For example, the State of Virginia just a few months ago announced to the press that it wasted $3 million last year on consulting engineers for design work that could have been done by an enlarged state highway department. In computing this extra cost of the consulting engineer, it failed to include the cost of a new $5-million building requested by the highway department to house the employees who would replace consultants.

Unfortunately, it seems to be next to impossible to secure accurate and comparable cost figures for government engineering. Two years ago a Senate Committee in California did make a study of engineering costs for projects handled by state employees in comparison with fees charged by consulting engineers. Their report indicated that a consulting engineer could do the job more efficiently and at a lower cost. Despite this report, the State of California still handles practically all engineering work with civil service engineers.

Size of Government Staffs

The consulting engineer realizes that most public agencies are overstaffed rather than understaffed. Public agencies expand their engineering department whenever their work load is increased, and then when the work gets back to normal they have to make "work" to keep the enlarged staff busy. This is a costly way to operate, as private consultants know, but public bodies are not bound by the same considerations as regular business.

Every consulting engineer also knows that his own office is operated much more intelligently and efficiently than most government agencies. He knows that he could not hire the type of engineer he needs for his own firm at the salaries the government pays, and he knows that three poor engineers, no matter how cheaply hired, are not the equal of one good one.

The consulting engineer knows these facts, but how can he sell the very man whose career depends upon the application of just the reverse philosophy?

The Committee of One-Hundred feels that consulting engineers must sell their services by using the same story with different approaches at the several levels of government. The basic sales story is simple: give the taxpayer better engineering at lower cost by using consulting engineers engaged on a fee basis.

The proper approach is more complicated.

Federal Projects

On the Federal level it often is necessary to work through elected officeholders or the very top executive officers who are extremely sensitive to political affairs. Most of the large consulting firms understand this and have Washington offices or representatives to put their sales story before individual Congressmen, Congressional Committees, or top administrative officials. This is no way implies using 5 percenters or commission agents. Most of these top men understand that the function of government should be to govern and administer, not to compete with private business. These top officials are, almost without exception, anxious to encourage private enterprise, and they are extremely cooperative when properly approached.

The small consulting firm seldom has the time or the money to deal personally with top men in the Federal government. Instead, these firms must work through consulting engineer associations to get their arguments to the right place. The Consulting Engineers Council, the National Society of Professional Engineers, and the American Institute of Consulting Engineers all have been working conscientiously to show Federal agencies where they can economically use the services of consultants. The Consulting Engineers Council has been particularly active in this work during the last year, and has received assurances and indications that the Bureau of Public Roads, the General Services Administration, and similar government agencies encourage rather than discourage the use of engineers in private practice. Certainly this is the attitude of the officials at the top, even though it may take some time for the policies to filter down.

It is important, also, for the associations of consulting engineers to get the intelligent support of other influential groups that favor private enterprise. An example of failure in this area is the well-known publication by the United States Chamber of Commerce in which the author urged the expansion of state highway departments as opposed to

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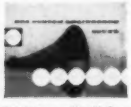

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the use of engineers in private practice. Consulting engineers individually and in groups complained to the U. S. Chamber of Commerce about this publication and the Chamber now probably understands its mistake, but this large and influential group should have been working for rather than against private enterprise all along.

State Projects

On state-level projects the consulting engineer's approach can be different. It is easier to reach a member of the state legislature than it is to get to a Congressman. Certainly the state representative is more sensitive to local demands. The state association of consulting engineers, backed up with factual material, can present its story to a state legislative committee and can be sure that it will be heard. Even the individual consultant is important to the individual state legislator.

In many states the highway commissioner is elected. Even when he is appointed, he reports directly to the governor. While he may have some interest in developing a large and powerful agency under him, he usually is more interested in what the people think of the roads, bridges, and tunnels the current administration is providing. This gives the consulting engineer a good chance to sell him on the advantages of private practice from both a cost and quality point of view.

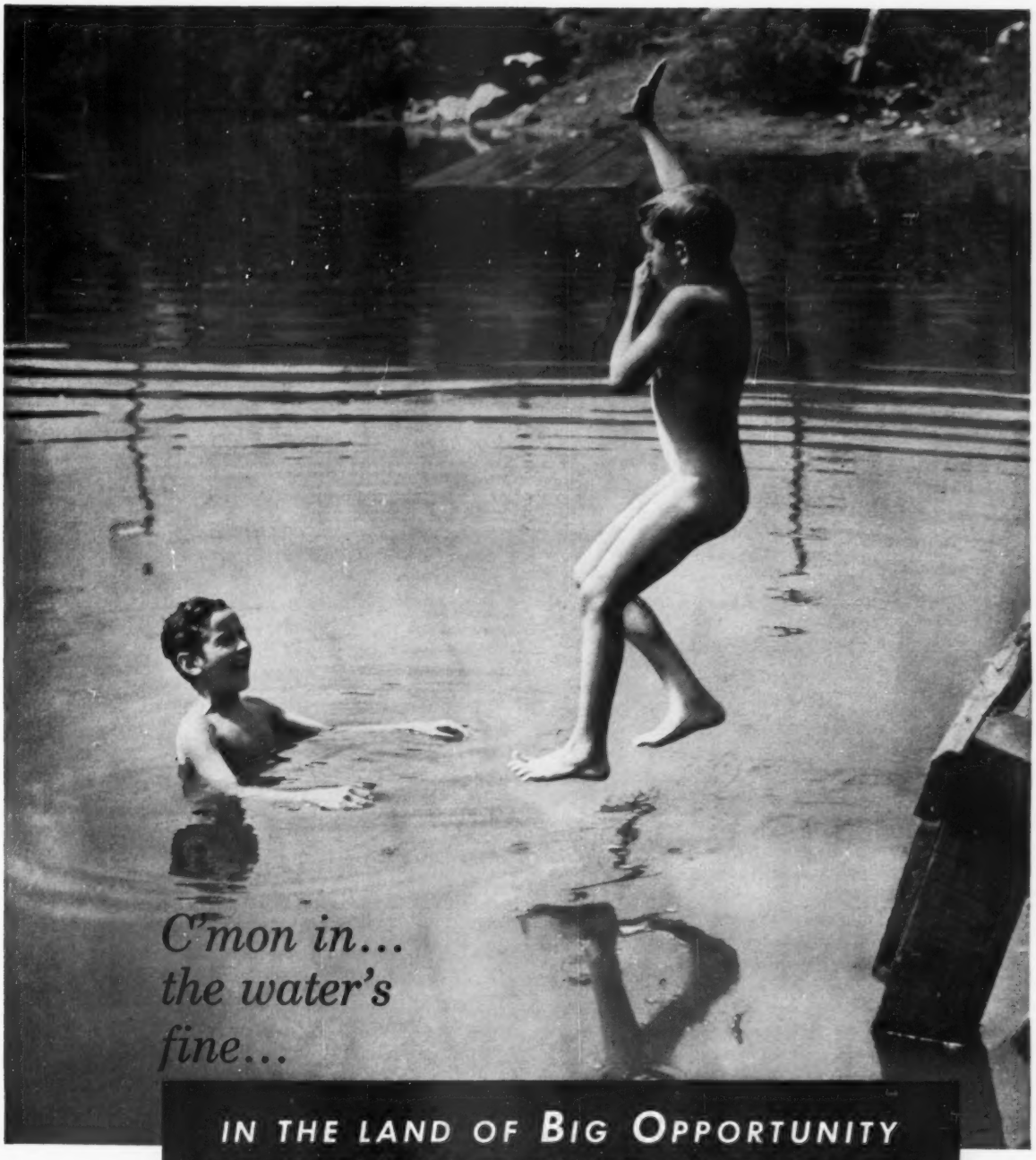
The consulting engineer should encourage highway commissioners to see their departments as small groups of highly paid policy-making engineers. Only in this way can the salary and the prestige of the top government employee be improved unless we continue the theory that "the more men under you, the more important you are."

The consultant also should remember that he seldom gains by fighting the government employee engineer. Instead, he should work with him at society meetings and show a sympathetic interest in his problems. The friendly department head will give more contracts than the avowed antagonist.

Local and County Projects

On the local city and county level, in all but the very largest cities, the consulting engineer's sales job is simpler. Here he usually is dealing with friends or at least acquaintances on the alderman or city council level. And most local government units do not have budgets that permit the establishment of engineering staffs geared to handle the peak project loads. The engineer can go into the city council meeting or into the office of the city manager and sell himself very much as he would to a private enterprise.

This does not mean that there are no problems. It is on the city-county level that we find most of



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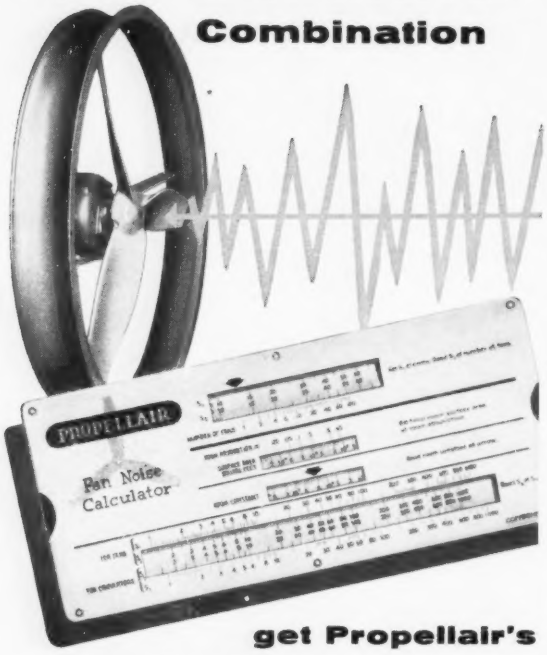

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the "free engineering" offered by manufacturers and materials suppliers. This means that city and county officials, just like managers of private enterprises, must be shown that "free engineering" is really the most expensive of all.

In the big cities, particularly those in which there is a well-entrenched political organization, there is usually another problem. Politicians, or at best, the Party, expect to be paid off in return for giving out contracts of any kind, and this even involves engineering contracts. Experience shows that there is no real answer to this. The engineer either must go along and thereby destroy his professional position, carrying other engineers down with him, or he must turn to other clients. As a practical matter, it seems impossible for individual engineers or even associations of engineers to fight successfully against these unethical practices.

It is also on the local level that one is called on most frequently to bid on a competitive price basis against other consulting engineers. Usually this is simply a matter of ignorance on the part of the public officials. When an association or even a consulting firm clearly points out the uneconomic as well as the unethical aspects of competitive bidding, the local government usually is willing to change its tactics.

Work Volume Remains High

Despite all of these difficulties consulting engineers encounter in trying to convince all the various levels of government as to the advantages derived from using engineers on a fee basis, the fact is that an amazing amount of work at local, state, and Federal level is done by the consulting engineer. There is always some point at which the government engineering group finds itself overworked and is forced to call for outside help. This is the consultant's opportunity to do an outstanding job that will prove his value. Here is his chance to show that his engineers can do a better job at a lower cost. Unfortunately, consulting engineers have not always made the best use of this opportunity. It is a regrettable fact that there are examples of public works designed by consulting engineers that do not compare with some done by government employee engineers. Every time a consulting engineer does an inadequate job for a government agency, he can be sure that he is giving that agency just the ammunition it needs to fight for an enlarged budget and an increased staff.

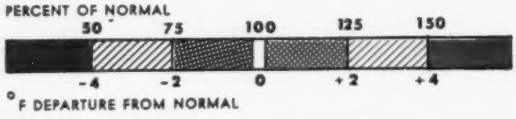
Conversely, a completed, well-designed, and efficiently executed public project is the best sales story that a consultant can offer. If the consulting engineer consistently offers his government this type of work, he can be sure that his share in public projects will increase in the years ahead. ▲▲

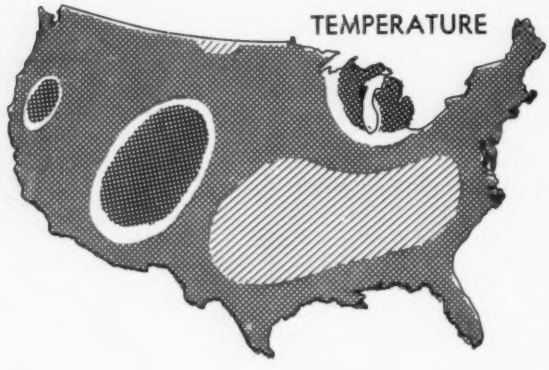
KRICK WEATHER OUTLOOK

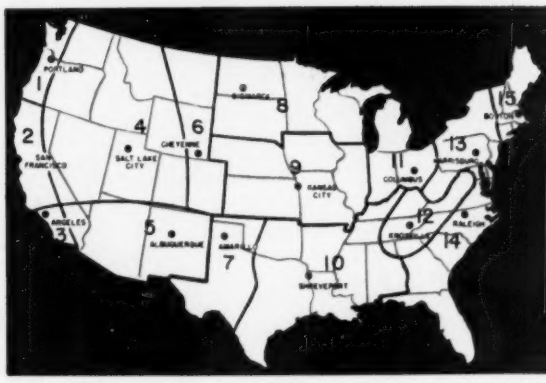
JUNE 1958

Prepared Exclusively for CONSULTING ENGINEER

PRECIPITATION







CONSTRUCTION DAY FORECAST LOCATIONS

CONSTRUCTION DAY CRITERIA

To be considered a construction day on these charts, the day's maximum temperature must be more than 38 degrees. There must be less than six inches of snow on the ground. There must be less than six hours of active precipitation between the hours of 7 a.m. and 5 p.m. There can be no more than one inch of rain on the preceding day.

JUNE HIGHLIGHTS

June 1958 will be generally warmer than normal over most of the United States. Notable exceptions to the warmer regime will be the Central Rocky Mountain region; the Klamath Valley of Oregon; and the upper Great Lakes states of Wisconsin and Michigan. These areas generally will average from one to two degrees below normal. Elsewhere, temperatures will range nearly two degrees above normal and up to four degrees on the average through the Mississippi and Ohio Valleys. Precipitation will be near normal or above through the heart of the country. Above normal moisture can be expected in the Pacific Northwest and the northern Rockies, as well as in the Great Lakes-New England area. Below normal moisture will feature June in southern California, southern Texas, the northern Plains and the southeastern states of Mississippi, Alabama, Georgia, and the Carolinas. A noticeable lack of important cool outbreaks from Canada will feature June weather, and generally warm temperatures will cover the country just prior to mid-month and again toward the end of the month. Frequent shower activity almost everywhere will cause brief work interruptions, but the lack of prolonged general storminess in most sections will mean June 1958, in general, will be a better construction month than was the wet, frequently cool June of 1957.

TEAR OUT ALONG PERFORATION.

These forecasts are prepared by Irving P. Krick Associates, Inc., the world's oldest and largest weather engineering firm. The forecasts are based on methods developed by this group at California Institute of Technology prior to World War II. After the War, the methods were adapted to high speed electronic computing machines to shorten the time required to solve the complex problems of the atmosphere. Ultra-long range forecasts, up to a year or more in advance, are now available. Information on other Krick weather services is available by writing to the home office of the firm at 460 South Broadway, Denver, Colorado.

CONSTRUCTION DAYS

JUNE 1958 ESTIMATES															
LOCATIONS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
HIGHEST	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
LOWEST	25	28	29	27	29	26	28	24	24	27	26	27	24	26	23
AVERAGE	28	29	30	29	30	28	29	27	27	29	28	28	27	28	26
ESTIMATE	27	29	30	29	30	27	30	27	28	29	27	28	26	29	25

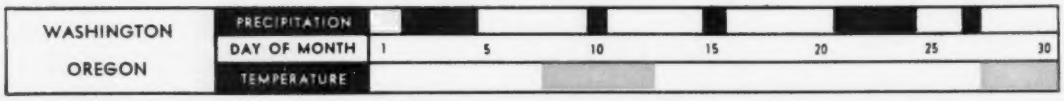
These estimated construction days for key cities in the United States should be interpreted as an average of estimated conditions over the forecast area. To obtain the best results, the forecast number of construction days should be compared with the temperature and precipitation anomaly maps and the timing estimates to determine the probable number of construction days in your locality. The forecast construction days are based on average construction day requirements as defined under "Construction Day Criteria," and should be adjusted for individual operations.

JULY AVERAGE AND RANGE*															
LOCATIONS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
HIGHEST	31	31	31	31	31	31	31	31	31	31	31	30	31	29	30
LOWEST	30	29	31	30	29	27	29	28	23	28	26	26	21	24	26
AVERAGE	30	31	31	30	31	29	30	30	28	30	29	28	28	28	29

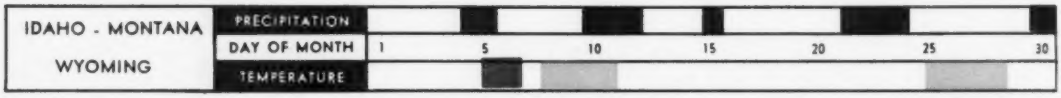
AUGUST AVERAGE AND RANGE*															
LOCATIONS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
HIGHEST	31	31	31	31	31	31	31	31	31	31	30	31	30	31	31
LOWEST	27	29	29	28	30	27	27	26	24	26	26	27	26	25	23
AVERAGE	30	31	31	30	31	30	30	29	28	30	29	30	29	28	27

*Historical Average, Not a Forecast

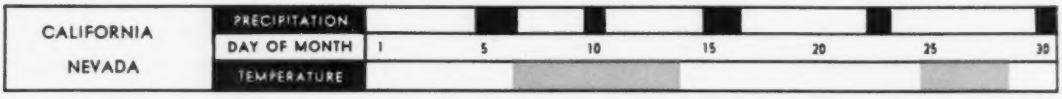
TIMING OF



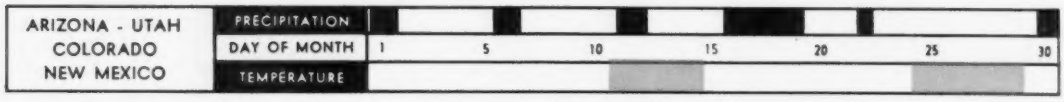
Showers indicated around 10th will be mostly in eastern areas. Showers around 15th will be confined to southern Oregon.



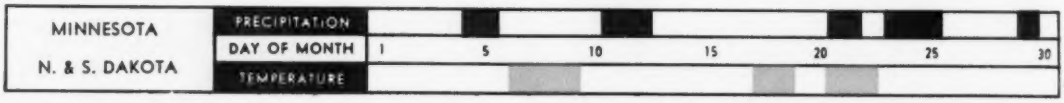
Showers indicated for around the 15th will occur mostly in southern Idaho and Wyoming. Low temperatures during cool outbreak will be about 34/38.



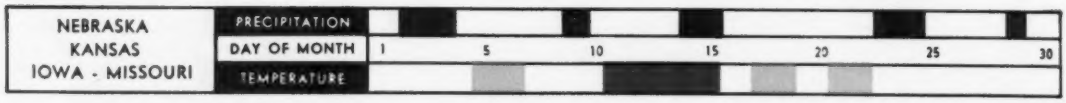
Showers indicated around 5th and 10th are for Nevada only. Showers at month end also refer mostly to Nevada. Temperatures will rise into 100's during final warm period.



Except for fairly unsettled period shown between 15th-20th, most activity will be spotty showers. Showers around 11th are expected mainly in the north.



Showers following 10th will occur mainly in southern areas; around 20th-22nd in western Dakotas; 24th-25th mainly in Minnesota.



Cool period between 10th and 15th does not apply to Kansas; temperatures there during period will be in 80's.

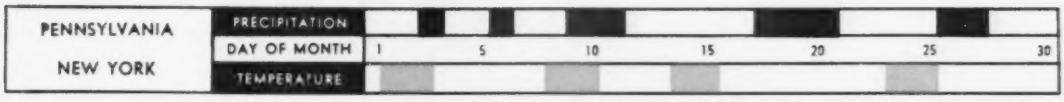
Most precipitation in this area will be just scattered showers, except for fairly general rains around the 25th.

OF SIGNIFICANT WEATHER EVENTS

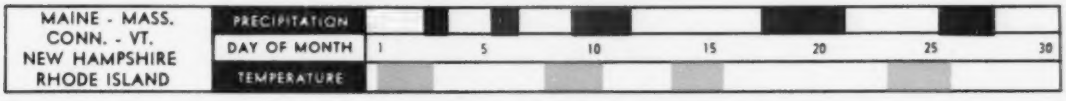
RAIN
SNOW
WARM
COLD

The timing bars below are intended to indicate periods of important general storminess and important departure from temperature normals in areas indicated. They are highly accurate over the area indicated, but are too general to pinpoint small local storminess or showers. Allow one day on either side of indicated storm or extreme temperature periods for general planning. Combination rain or snow shading indicates either one or both.

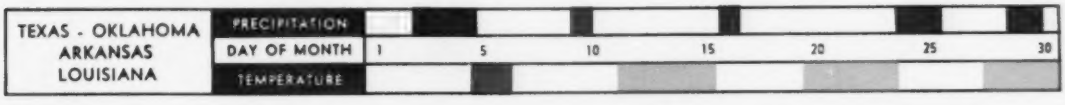
Temperatures during warm periods will rise into 90's. Warm spell prior to 25th will be mostly in New Jersey.



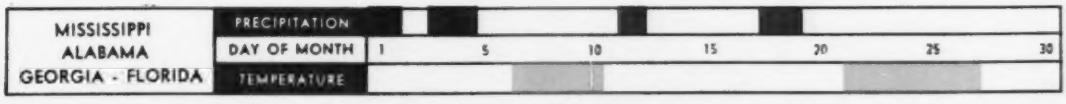
Temperatures during warm spells frequently will go into 90's. It will be warmest in the area east of the Appalachians.



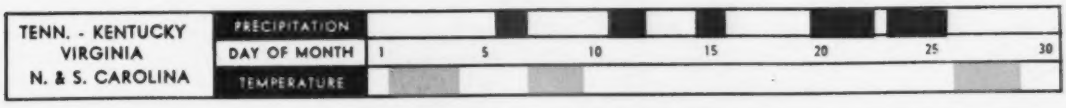
Precipitation is mostly of the showery type through the month and not prolonged. Warmest period will occur around the 25th.



Cool period around 5th is not important; temperatures will only go down into the 50's. Warm spells are quite important.

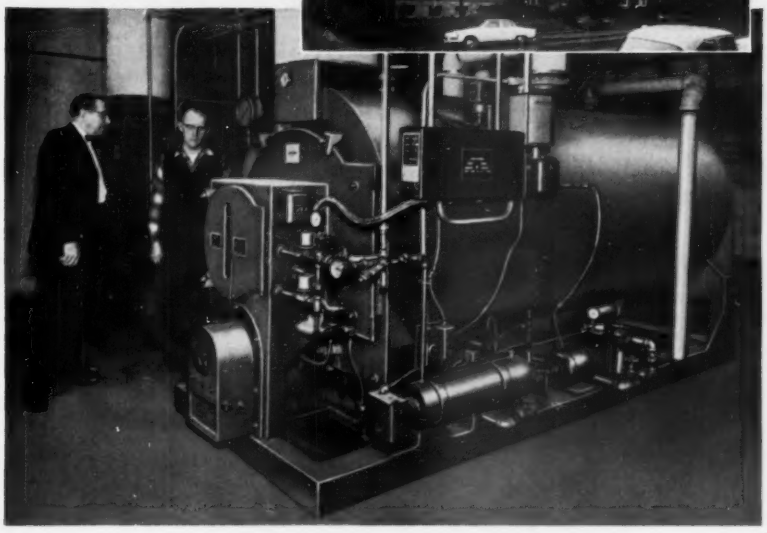


Showers on 1st are expected mainly in Georgia; additional showers in Mississippi around the 14th. Showers in Florida will occur around the 20th.



Shower period around 20th will occur mostly east of the Appalachians. Warm period between 25th and 29th also is most important in east.

Two 75 H.P. Continental Automatic Boilers at Gordon Junior High School, Coatesville, Pa. Theodore Stetler (right) superintendent of maintenance shown with Merrill A. Squier, of Besco Sales, Continental Boiler representative.



HEATING COSTS CUT 21% with new Continental Boilers

In 1955, the Coatesville, Pa. school district purchased two new 75 H.P. Continental Automatic Boilers firing #5 oil to heat three adjoining school buildings from a central plant. The new boilers saved $2,614.51 in the first two years of operation. This is a 21% reduction in heating costs.

Merrill A. Squier, of Besco Sales, Continental Boiler representative in the Philadelphia area, says:

"You can count on Continental for highly efficient, low cost steam or hot water. Because of the simplified design, maintenance and downtime are cut to the bone. There are no refractory baffles to burn out, leak and cause short circuit of gases. Free rapid water circulation keeps heating surfaces clean. Steam and water spaces are easily checked through openings. Clean-out is easy."

Continental Boilers, firing oil or gas, are available in models from 20 to 600 H.P. with on/off, low-high-low, or modulating controls. For steam heating or process work at pressures from 15 to 250 lbs., or hot water heating at low or high temperatures. Literature on request.

BOILER ENGINEERING & SUPPLY COMPANY, INC.
Phoenixville, Penna.

The Continental AUTOMATIC BOILER

A HALF CENTURY OF BOILER MANUFACTURING EXPERIENCE

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DISTRICT OF COLUMBIA
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FLORIDA
Jacksonville—H. L. McMurry & Co.
Miami—H. L. McMurry & Co.
Orlando—H. L. McMurry & Co.
Tampa—H. L. McMurry & Co.

GEORGIA
Atlanta—Mechanical Associates
Augusta—Tarte Boiler Repair Co.

ILLINOIS
Chicago—Automatic Steam Sales Co.

INDIANA
Indianapolis—Plibrico Sales & Service Co.
New Albany—Falls Cities Boiler & Machine

LOUISIANA
New Orleans—Cressy Sales Company

MARYLAND
Baltimore—Heating Services, Inc.

MASSACHUSETTS
Dorchester—Lewis National Corp.

MICHIGAN
Dearborn—Kramer & Associates, Inc.

MINNESOTA
Minneapolis—Oil Burner Service Co., Inc.
St. Paul—Lincoln Equipment Company

MISSISSIPPI
Jackson—Climate Engineers, Inc.

MISSOURI
St. Louis—Continental Boiler & Sheet Iron Works

NEBRASKA
Omaha—Midwest Utility Service Co., Inc.

NEW YORK
Buffalo—W. J. Clark Equipment Co.
Gloversville—Olin T. Caldwell & Co.
Hudson Falls—Boiler Equipment Co.
New York—Thermal International, Inc.
Rochester—Ernest J. Rookey
Syracuse—U & S Supply Corp.

NORTH CAROLINA
Greensboro—M. G. Newell Co., Inc.

OHIO
Cincinnati—Kenneth B. Little Co.
Cleveland—P. M. Equipment Co.
Toledo—Air Conditioning Distributors, Inc.

OKLAHOMA
Oklahoma City—Mecha-Line Co.

PENNSYLVANIA
Phoenixville—Besco Sales, Merrill A. Squier
Pittsburgh—John C. Gregg Company

RHODE ISLAND
Providence—Weatherall Engineers, Inc.

TENNESSEE
Knoxville—Boiler Supply Co.
Memphis—Middle States Associates, Inc.
Nashville—Boiler Supply Company

TEXAS
Dallas—Rodgers Engineering Co., Inc.
Fort Worth—J. P. Philibert

UTAH
Salt Lake City—Power Engineering Company

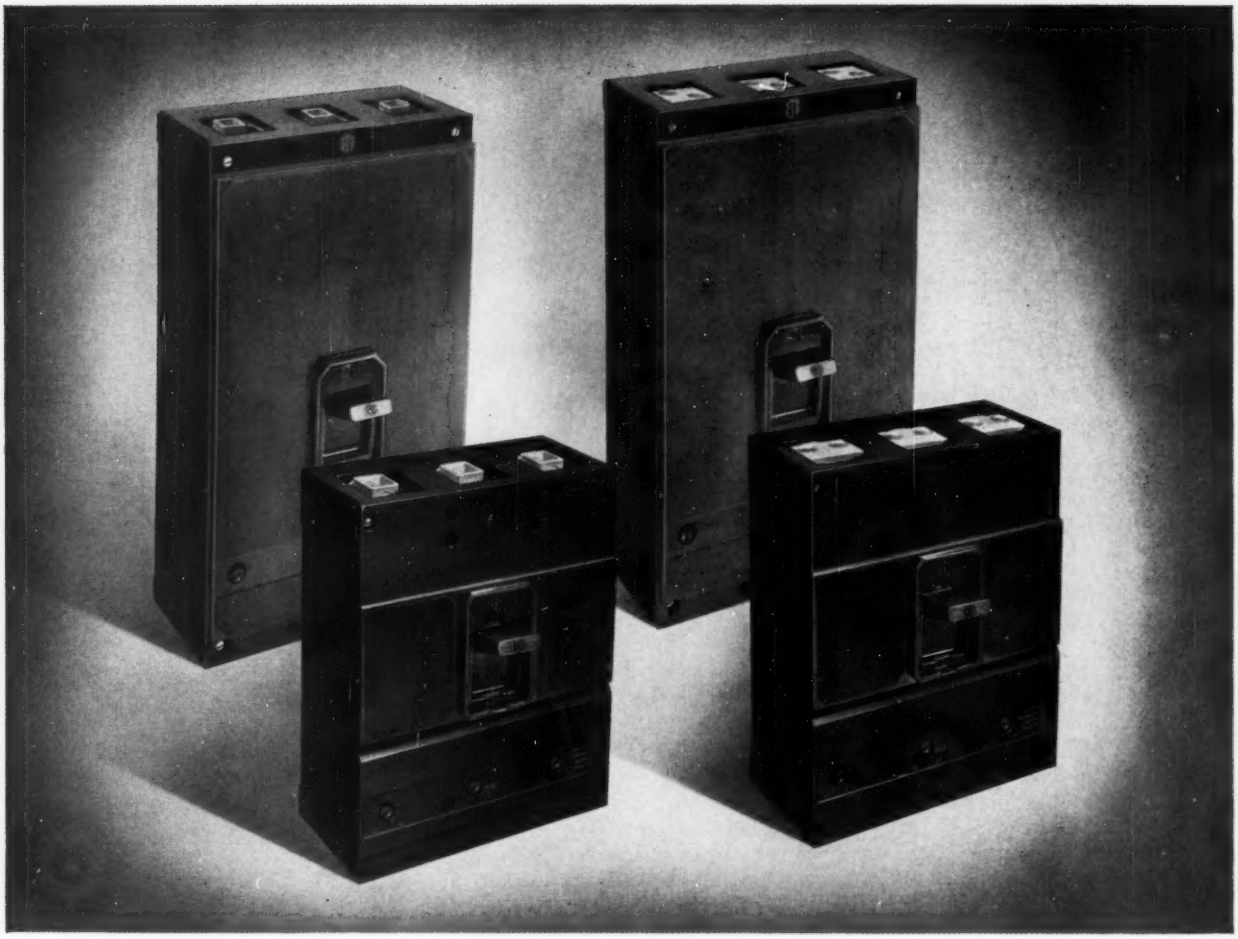
VIRGINIA
Suffolk—C. Fred Bailey

WISCONSIN
Milwaukee—Industrial Steam, Inc.

Announcing

TWO NEW I-T-E Molded

New, compact JK and JKL molded case circuit breakers are the two latest additions to industry's most complete and diversified line

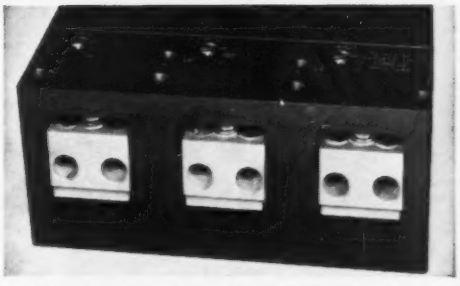


SPECIFICATIONS

	Continuous Rating	Interchangeable Trip Unit	Interrupting Rating	Front-removable lugs	Dimensions
JK	70-225 amp	yes	(at 600 v) 25,000 amp (at 240 v) 30,000 amp	yes	9 x 11 x 4 1/16 in.
JKL	125-400 amp	yes	(at 600 v) 25,000 amp (at 240 v) 40,000 amp	yes	9 x 11 x 4 1/16 in.

Case Circuit Breakers!

- **Interchangeable trip unit construction**
- **225 and 400 amp continuous ratings**
- **25,000 amp interrupting ratings**
- **Exclusive new front-removal lug design**



I-T-E Molded Case Circuit Breakers have exclusive, completely enclosed terminals for greater safety.

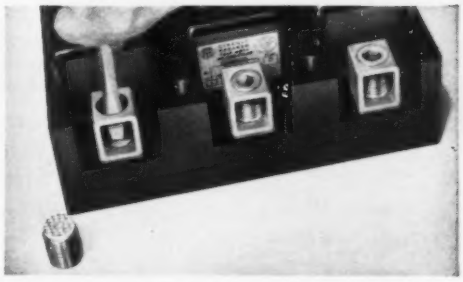
...in a size only two-thirds that of breakers previously required

As one of the pioneers in the electric circuit breaker field, I-T-E has consistently maintained its leadership—not only in developing new products to meet the growing needs of industry, but in constantly seeking ways to improve existing designs.

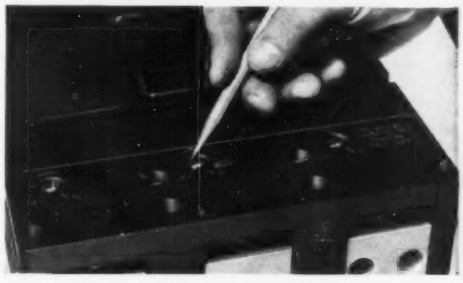
The new JK and JKL I-T-E Molded Case Circuit Breakers are but one more example of I-T-E advances in the interest of continued improvement. They have the same famous built-in I-T-E "extra quality—at no extra cost."

These new JK and JKL breakers are identical—performance-wise—with existing K and KL breakers, and not only do they represent space economy, but in certain instances an actual saving in initial cost. Compare with any other equally rated breaker.

See your I-T-E distributor for details on these new breakers or write I-T-E Circuit Breaker Company, Small Air Circuit Breaker Division, 19th & Hamilton Sts., Philadelphia 30, Pa. In Canada, Eastern Power Devices Ltd., Port Credit, Ontario.



New I-T-E JK and JKL breakers have an exclusive lug which is installed from the front of the breaker. This assures easy interchange of trip units when the breaker is in place.



I-T-E JK and JKL frame breakers provide external front adjustable instantaneous trip design, an I-T-E exclusive.

I-T-E CIRCUIT BREAKER COMPANY
PHILADELPHIA, PENNSYLVANIA

DRY YOUR OILS.....

AT LESS COST WITH

NEW

FIL-THERMO-VAC

by BOWSER ESTABLISHED 1885

LUBRICATING...
INSULATING...
COOLING...
HYDRAULIC...

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- synthetics
- vegetable
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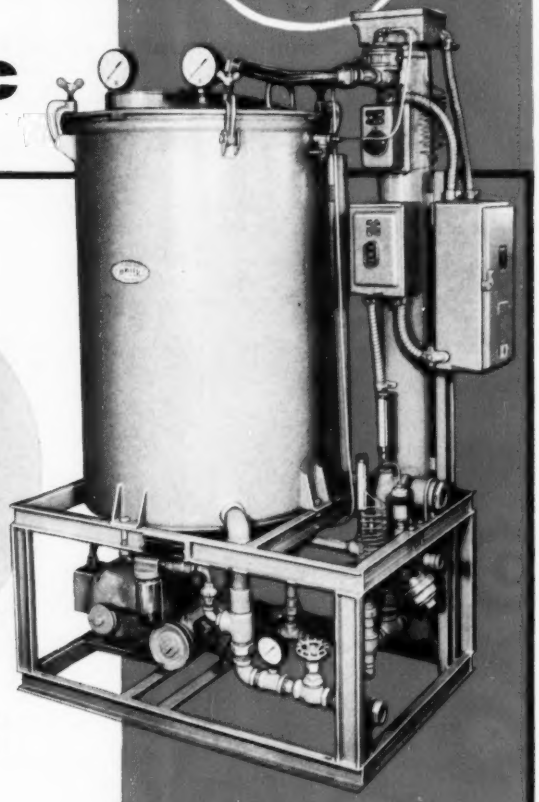
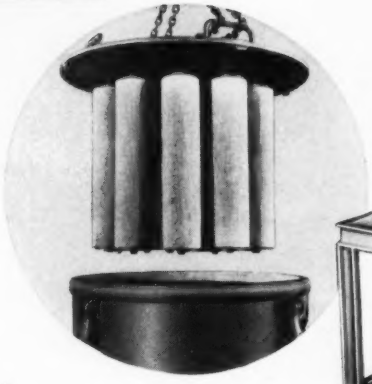
- fish





Oil disperses through fiberglas micro-filters into vacuum chamber where water and other volatiles are drawn off . . . condensed and ejected.

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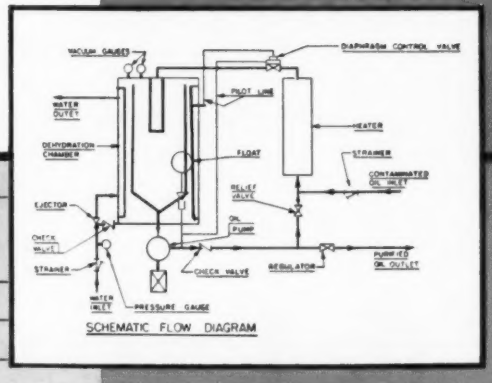

SCHEMATIC FLOW DIAGRAM

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FORT WAYNE, INDIANA

Gentlemen: Send FACTS ABOUT FIL-THERMO-VAC to:

Name _____

Company _____

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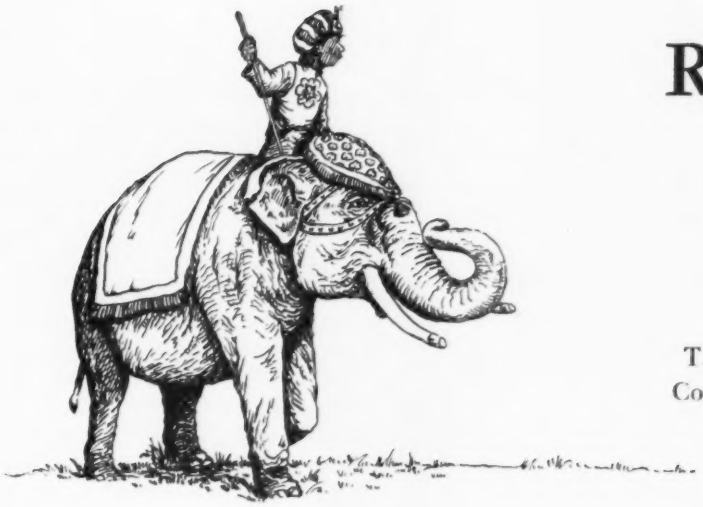


Report From India

T. DRIEBERG and S. S. PANI
Consulting Engineer Correspondents

THERE ARE FEW consulting engineers in India. There are none with the organization or qualified personnel to supervise major industrial or public works projects. Therefore India's federal and state governments and private clients must turn to foreign consulting firms.

CE exclusive

Most of the engineers come from Great Britain, but starting with the first five-year plan in 1951, engineering aid came from the United States, West Germany, Russia, France, and Switzerland. Some of this technical assistance is provided at government level—for example, from the United States under the International Cooperation Administration, and from England under the Colombo Plan.

Investment Problems

Private businesses in India have additional reasons for using foreign consultants. Industrialists considering major expansion plans seek long-term foreign credit for the purchase or imported capital goods. Technical aid is linked increasingly with such capital investment.

As an instance, Kaiser, the American firm, currently is providing both engineering aid and capital credits for the Tata Iron and Steel Company, Bombay, to boost output at the company's Jamshedpur ingot steel plant from 1.2- to 2-million tons annually. Kaiser also is working with Birla Brothers, India's largest industrial group, on a 20,000-ton aluminum plant as well as on bamboo paper and rayon pulp mills.

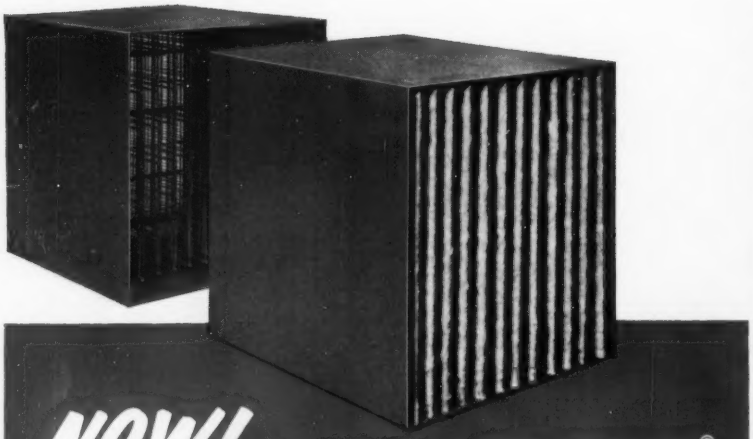
Such huge projects are beyond the scope of India's consulting engineers. For the most part, these engineers become consultants upon retirement from a firm or government services. They usually are expert only in a limited field. They work alone, without assistants, and only smaller companies use their services. Some junior engineers who have studied and worked abroad have set up offices, but they are handicapped by a lack of facilities and business experience.

Fees and Practices

Fees charged by Indian consultants range from 3½ to 7½ percent of the project's total cost, depending on the nature and extent of the services. In contrast, foreign consultants charge up to 12 percent of the project cost, with traveling and living costs extra. This is higher than they would charge in their own countries, but they feel that their price is right for foreign work.

Consulting engineers in India have no regional or national organizations, although there have been attempts to form them. Several consultants belong to the Indian Institution of Engineers and are supposed to abide by its code of ethics—modeled on professional practice in Britain. There is, however, no policing body, and it is impossible to tell how well the code is followed.

A more important difficulty in enforcing any set of standards is that consulting engineers have no legal protection in India. Anyone, whether an engineering graduate or a technician with no degree at all, can set up as a consultant, and no legal action can be taken against him. And because of the tremendous industrial expansion of the first and second five-year plans, very little is done about it.



NOW! Cambridge AEROSOLVE® Filters Available in HIGH VELOCITY MODELS!

80% More Air per sq. ft. face area

45% Less Area per given cfm.

. . . at No Increase in Pressure Drop

Already famous for its low owning and operating cost, the Cambridge AEROSOLVE Filter in the new high-velocity models offers even greater economies. Compare:

	High-Velocity AEROSOLVE	Standard AEROSOLVE
Rated Capacity (24" x 24" face area)	1800 cfm.	1000 cfm.
Face Velocity	450 fpm.	250 fpm.
Area of Filter Medium	86 sq. ft.	43 sq. ft.
Ratio, Filter Area to Face Area	21.50 to 1	10.75 to 1

Choice of 3 Efficiencies

High-velocity AEROSOLVE cartridges are, like the Standard models, available in efficiencies of approximately 95%, 85% and 35% (discoloration test with atmospheric dust). All cartridges are interchangeable and are easily secured in permanent cadmium-plated frames by quick-acting fasteners at the corners. No other strainer-type air filter of comparable efficiency approaches the low pressure drop of these units.

Other than infrequent cartridge changes, AEROSOLVE filters require no maintenance. Installation is also low in cost. In high-velocity systems, the new units obviate the need of V-ing the filter bank and result in even greater installation and maintenance economies.

Write for Bulletin 130

Cambridge Filter Corporation

730 E. Erie Blvd., Syracuse 3, N. Y.

Makers of the ABSOLUTE® Filter— World's Most Efficient Air Cleaning Device

REPRESENTATIVES IN PRINCIPAL CITIES

The client is thankful to find a man who calls himself an engineer, qualified or not.

India is taking steps to alleviate the shortage. According to the National Planning Commission, 35,000 additional engineering graduates and 60,000 technicians will be needed between now and the middle of 1961, when the second five-year plan draws to a close. In 1955 the total number of engineering graduates was 31,000, and there were 41,000 technicians. Because present schools can turn out only 20,000 graduates annually, by 1961 India will be shy 15,000 engineers and 30,000 technicians. The government is trying to close this gap, but is handicapped by a shortage of science instructors.

Despite this handicap, there are now 75 engineering colleges, compared to 32 in 1947. In the same period the number of institutions providing training for technicians has leaped from 50 to 127. In addition, 19 engineering colleges and 41 polytechnics are expanding, and five new engineering colleges and 21 polytechnic institutes have been established.

Training Abroad

In addition, several hundred Indians are receiving engineering training abroad — in Britain, the U.S., West Germany, and Russia.

Some 180 engineers already have gone to the Soviet Union to be trained for employment in the new 1-million ton Indo-Soviet steel plant at Bhilai. Of these, 90 already have returned, and more are going this year. A total of 680 engineers and technicians will be trained in the Soviet Union for this plant.

The Ford Foundation is helping train engineering personnel for two other million-ton state-owned steel plants at Rourkela and Durgapur. The first 200 trainees are already in the United States.

Another 200 engineers and technicians will be trained in Britain, and 150 will go to West Germany. The Durgapur plant is being

ONLY JENN-AIR EXHAUSTERS OFFER TRUE LOW CONTOUR

The Big Difference is in the Installed Height

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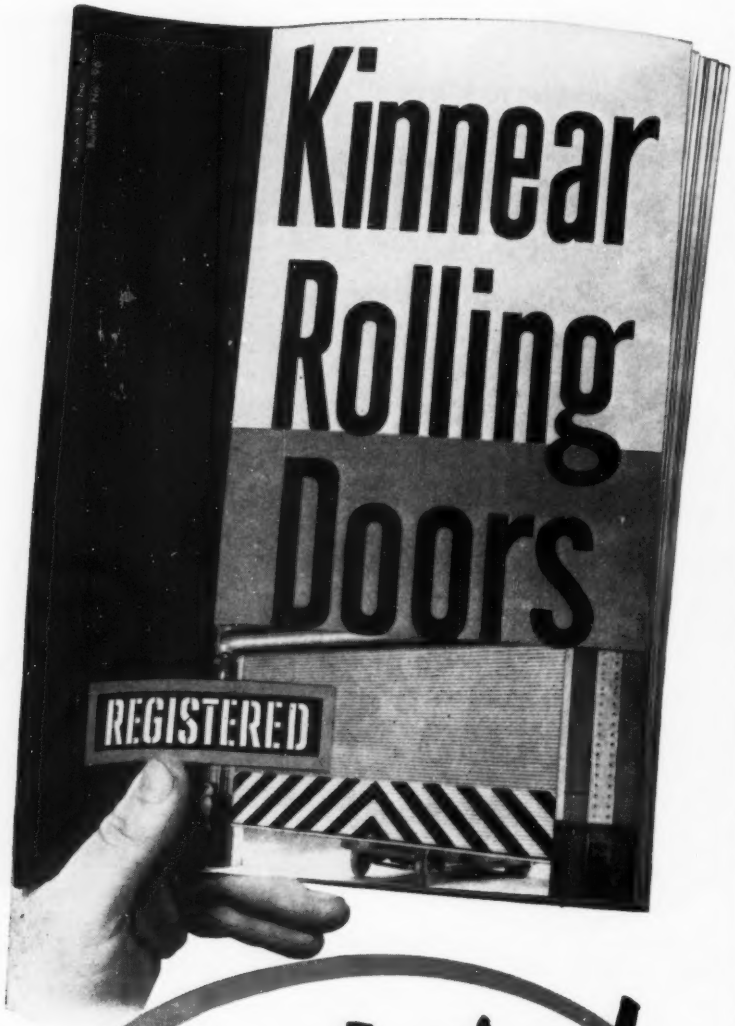

Get Action!

—The *upward action of interlocking slats that coil compactly above the opening:* That's the *action* (originated by Kinnear!) that provides an unbeatable combination of lower door costs and higher door efficiency. Kinnear Rolling Doors make all space around doorways usable at all times, open completely out of the way, give you a rugged curtain of all-steel protection against wind, weather, fire, and vandals. *Often* delivering up to 50 years or more of daily, low-maintenance service, they're also REGISTERED — all parts of every door can always be accurately duplicated from master details kept permanently in fireproof vaults. Get *all* these Kinnear Rolling Door benefits and more; write for this latest catalog, now . .

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erected with financial and technical aid from a British steel consortium, while the German firm of Krupps-Demag is backing the Rourkela project.

Besides these training programs, every year some 200 Indians go abroad on their own to study engineering in Britain or the United States. In this connection the Engineering Personnel Committee of the Planning Commission notes: "A small number of engineers who get trained in this manner settle down to jobs in countries like the United Kingdom and the United States. Some of these are trained in specializations which are not required in India at present; there are others whose skills are needed in India, but who settle abroad where they find better opportunities. We should, therefore, aim at making the expensive foreign training more purposeful for suitable positions in India."

The committee notes complaints that the standard of engineering graduates from Indian institutions is deteriorating. "These lower standards in engineering colleges are attributable to a number of factors: dearth of teachers of the right caliber; inadequate facilities for practical training; ineffective methods of examination and enforcement of standards; and possibly insufficient equipment in some of the engineering institutions."

Government Departments Suffer

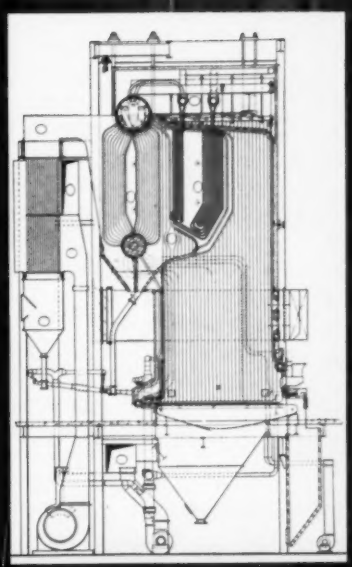
The great demand has resulted in excessive mobility "at a rate that hampers projects." Job shifting by engineering personnel has assumed "disconcerting proportions" . . . in one state government nearly half the engineers recruited in one year resigned to get better jobs.

Finding qualified engineers with practical experience is particularly difficult for state-owned enterprises and government departments because pay scales are well below those in private firms. For instance, one major state fertilizer project has called for junior mechanical de-

Mile High Plant Steam Generator Fired By DETROIT ROTOGRATE STOKER

Southern Colorado Power Co

Note — This information is out dated. Another Roto Grate is being added here, to fire a new 200,000# per hour unit.



This new unit which triples the capacity of the plant consists of a Babcock and Wilcox two-drum single pass steam generator fired by a Detroit RotoGrate Stoker having six feeders and distributors. This plant is at 5,300 feet above sea level. Capacity of above unit is 150,000 pounds of steam per hour at 860 psi, 915° steam temperature with preheated air at 350° F.

Design is based on bituminous coal:

B.T.U. per lb as fired	10,828
Moisture	8.84%
Volatile matter	33.72%
Fixed Carbon	44.69%
Ash	12.75%
Sulphur (separately determined)	0.7%

However, operation has been completely successful with coal from various mines in the vicinity.

Detroit RotoGrate is an exceptionally efficient spreader stoker with overlapping highly restricted grates that move slowly forward discharging ash at the front. Permits high burning rates with all Bituminous coals, Lignite or refuse fuels. *Write for Bulletin.*

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RELAYS

LONG BRANCH, N. J.

sign engineers with a degree from an Indian or foreign university, and two to five years practical experience, for a starting wage of $85 a month. An engineer with such qualifications could earn double this sum in a private undertaking.

Work of Foreign Consultants

Consultants are becoming more and more important to India. For example, Hindustani Aircraft, in Bangalore, formed during the war to service Allied aircraft, now turns out bus bodies and railway passenger cars with the help of consulting engineers from West Germany. Hindustan Machine Tools Company, Bangalore, also uses German consultants. A vast lignite project at Neyveli, Madras state, is using American engineers. Though sparked by Americans, initial machinery orders for this project were placed in West Germany. The trend now is toward American material.

American consulting engineers are working on the multipurpose Bhakra-Nangal project in Punjab, the Hirakud project in Orissa, and Damodar Valley Corporation projects in Bihar and West Bengal.

British consultants are associated with the heavy electrical goods industry, a lignite project, a shipbuilding yard, the aircraft industry, the Durgapur steel plant, and several other major projects.

Consultants from Switzerland are working with a state-owned railway coach factory, ordnance factories, and a state-owned machine tool factory.

Oil Exploration

Oil is another example. Until recently, all oil exploration in India was done by Russian and Rumanian groups. Indian oil men were trained in Russia and Rumania. A Russian team, surveying for oil possibilities, reported a number of places where oil discovery seemed likely. Though one major oil company reported that the Russians had discovered nothing that was

FIRST in Airfoil Bladed Fans

50% more used than any other make

"Chicago" Airfoil Fans solve 3 tough problems in Koppers Building

Consulting engineers, Peter F. Loftus Corporation, were faced with three limitations in planning the year 'round air conditioning system for this 28-year-old building:

1. Fans had to run extremely quietly because of adjacent offices.
2. Fan equipment rooms had to be small to conserve rental space.
3. No alterations on the exterior of the building were permitted.

"Chicago" Airfoil Centrifugal Fans met these specifications perfectly. Their efficiency (92%) enabled the consulting engineer to move the required volume of air with much smaller fans and motors. This not only saved valuable floor space, but also saved horsepower. Their quiet operation (65% less noise) prevented tenant complaints.

Engineers have recognized the superiority of "Chicago" Airfoil Bladed Fans since they were first introduced in 1951 and have specified them for . . .

General and heavy duty applications in . . .

- Air supply and exhaust
- Mechanical draft
- Industrial processing
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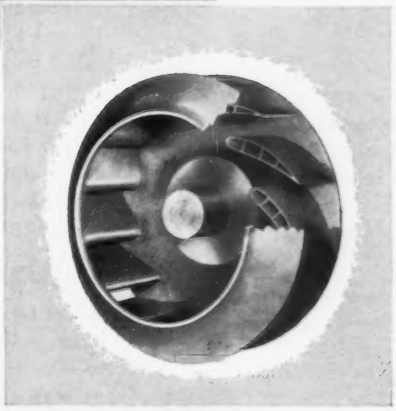
- High pressure and conventional ventilation

28-Year-Old Koppers Building Pittsburgh, Pa.

Air conditioning this 33-story building was the largest installation ever attempted in the Pittsburgh area.



65% less noise, 35% less horsepower, 92% efficiency with "Chicago" Airfoil aerodynamic wheel design

First major advancement in 40 years obsoletes conventional flat bladed designs.

Air passes over the all-welded airfoil shaped blades with less turbulence, greatly reducing air "roar" and current consumption.

Fans available in all capacities, classes and pressures.

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not known 10 years ago, the Russian report was well received.

At present the Rumanians are drilling in Jwalamukhi, East Punjab; the Russians are drilling in the Cambay area of Bombay state, and have another rig ready to begin drilling operations. All this work ostensibly is done by the India government.

The Assam Oil Company, a British subsidiary, has joined with the government of India in a joint venture (Oil India, Ltd.) for oil production in Assam state. Stanvac-India already has drilled two wildcat wells and moved to a third site in West Bengal.

The small but growing influx of American engineers, American machinery, and American capital into India is in marked contrast to the situation a year ago. Then India spurned Western aid with the argument that it easily could bear the burden in the technical and industrial fields. But the second five-year plan fast floundered in a sea of debt, incompetence, poor management, and wildly unrealistic proposals. Because India could not hope to accomplish the grandiose schemes without heavy foreign aid, the government had to reduce the plan to necessities only.

India then asked aid from the United States. This astounding request worked. A loan of $150 million from the U.S.-backed Export-Import Bank will be made available to India the next year. Another $75 million will come as a loan from the U.S. Other funds will be added later.

Atomic Energy, Too

Besides steel and oil, India is eyeing atomic energy. According to Dr. Homi J. Bhabha, chairman of the country's Atomic Energy Commission, India's industrial future depends on the rapid development of atomic power, for:

¶ India's known coal deposits cannot last more than 50 years even at the present low rate of consumption. If consumption were to in-

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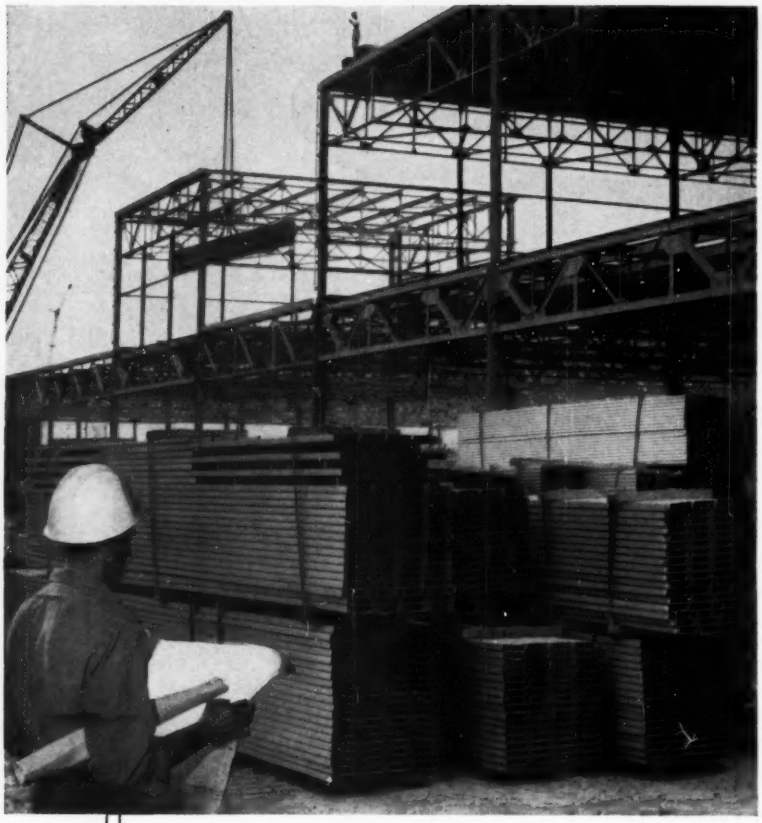

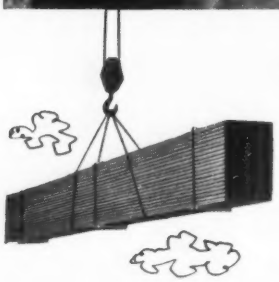

Cut field painting costs with Milcor Bonderized Deck!

Milcor's prime finish withstands rough handling

Shipping, storage, and erection can damage ordinary factory-applied prime paint. And, as you know, a finished paint job can be no better than the prime coat.

To assure a high-quality base for field painting, Milcor Roof Deck is Bonderized, then flow-coated with an epoxy-resin enamel, oven-baked to abrasion-resistant hardness. The result is the most durable prime finish ever applied to steel roof deck. If field painting is required, one coat will do the job instead of two.

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RD-14

crease to the same rate as the U.S., these reserves would be exhausted in a decade. Moreover, these coal reserves are concentrated in one region in eastern India; to transport this coal to rapidly expanding industrial centers in other parts of India places a great strain on the railways and holds up transport of other essential commodities. At the present rate of railway expansion, haulage facilities will fall short of demand by more than 25 percent in 1961.

¶ Even if India's entire hydroelectric potential could be developed, available electricity per capita still would be but a fraction of the West's.

¶ Even if petroleum consumption could be held to its present low rate of increase, the import bill in 20 years still would be $650 million annually.

¶ Over 75 percent of India's fuel needs now are provided by cow dung. To replace cow dung with coal, so the dung could be used as manure, would require 261-million tons of coal yearly. Target of the second five-year plan is only 60-million tons.

According to some widely accepted estimates, atomic energy would give India electricity at less cost than present thermal stations can produce it. According to the Commission, atomic generated electricity also would relieve the heavy strain on the railroads.

The Atomic Energy Commission controls India's atomic energy program. Headquartered at Trombay (Bombay) the Commission already is operating Aspara, a swimming-pool reactor, on two shifts a day, and has a group of scientists designing a new reactor of 10 to 20 Mw, using beryllium oxide as moderator. In addition, the Commission hopes to operate at least one power station with uranium and is considering a fusion reactor.

The Commission also plans to start construction of India's first nuclear power station this year, with completion slated for 1962;

Put Your Curtain-Wall Requirements in **EXPERIENCED HANDS . . .**

THESE FOUR CATALOGS show how Bayley can work with you on both steel or aluminum windows and curtain wall systems for buildings of all types. Copies will be gladly sent on request—or see Sweet's Architectural and Industrial Construction Files.

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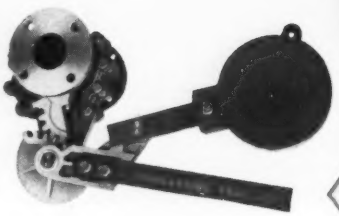
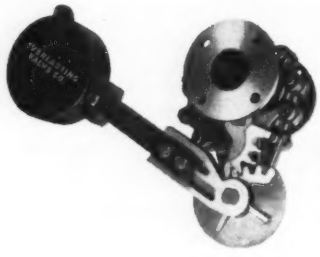


OPENING TYPE

to divert water to sprinkler deluge or water curtain systems, or to divert inflammable liquids to a point of safety.

Write for Bulletin E52C



CLOSING TYPE

to shut off the flow of inflammable liquids or to concentrate water or steam in fire mains.

Both types can be controlled thermostatically, electrically, or manually from any or many locations. Their design assures positive, dependable protection because they do not wedge and consequently cannot stick.

EVERLASTING Valves

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EV391

this pilot plant will use natural uranium for fuel, but by 1965 engineers hope to use India's more abundant thorium reserves, estimated at 500,000 tons.

More than 300 physicists and technicians will be added to the Trombay staff in 1958, boosting the total to over 900. To find more scientists, the Commission plans a scholarship program at Roorkee University, in Uttar Pradesh.

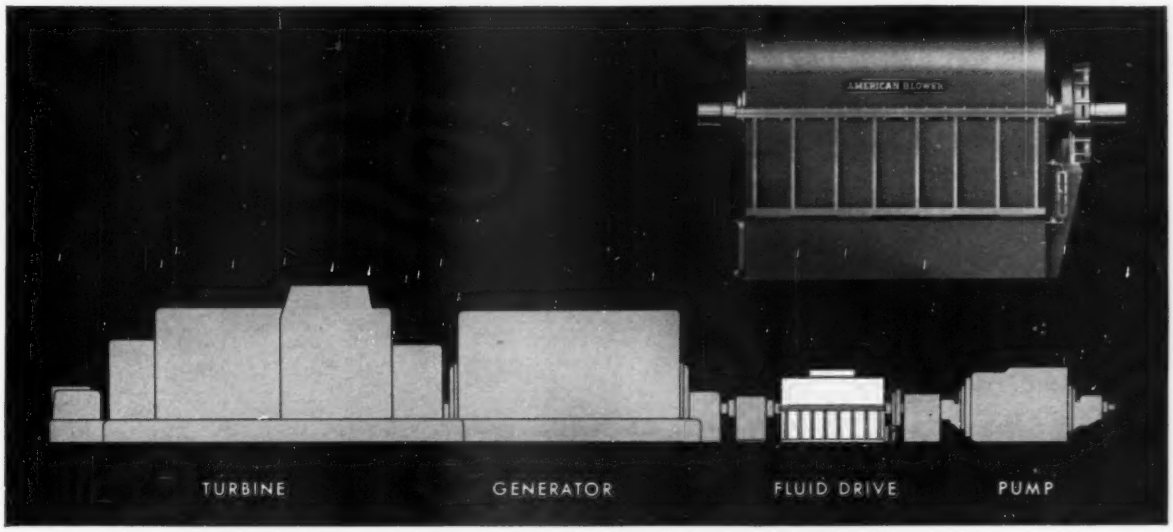
India's AEC has its fingers in other things as well. It has started construction of a small plant to manufacture reactor fuel elements and another to produce beryllium oxide. Both of these will be in Trombay. And the Commission is considering manufacturing zirconium for cladding and structural materials for reactors.

Fuel Resources

India is extremely rich in atomic fuels. Known reserves of uranium and thorium have an energy value more than 30 times the country's coal resources. Main source of fissionable material at present is Kerala state, in the south of India, where more than 30,000 tons of uranium are located. Recent research has shown new reserves of radioactive materials in Bihar state (northeast India) where there are upwards of 300,000 tons of thorium, 10,000 tons of uranium, and 80-million tons of ilmenite.

In addition, the new state-owned fertilizer plant at Nangal, Punjab will produce 70 tons of heavy water annually. Other fertilizer plants also will produce heavy water.

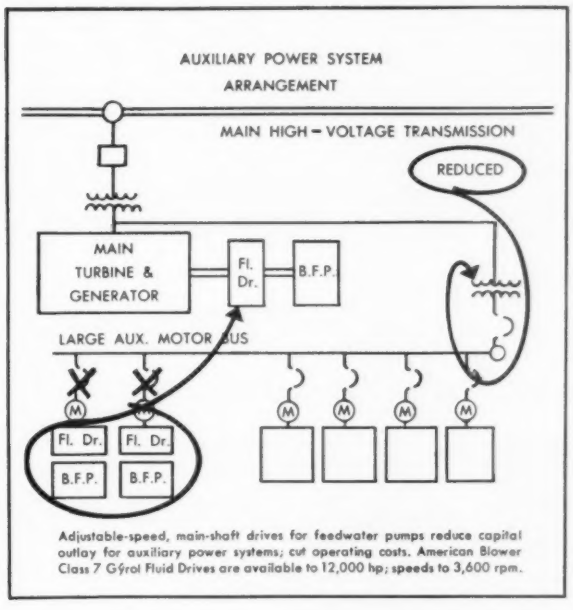
Long considered a poor country, India is actually one of the richest nations in the world in mineral resources. Much of the country's poverty can be traced to inexperience. But it is a young nation, and with the help of foreign engineers during this period when India is training its own, it should be possible for the country to move toward the day when India will be one of the world's "have" instead of "have-not" nations. ▲▲



American Blower *Gýrol*® Fluid Drive lets you:

Take boiler feed-pump power from main-turbine shaft . . . slash auxiliary costs!

Save price of motors, switchgear, conduit and cable. Release more power to consumer lines. Reduce operating costs.



Adjustable-speed, main-shaft drives for feedwater pumps reduce capital outlay for auxiliary power systems; cut operating costs. American Blower Class 7 Gýrol Fluid Drives are available to 12,000 hp; speeds to 3,600 rpm.

Savings of nearly $500,000 are predicted for two new 290-Mw units scheduled for service this year. Both use main-turbine feedwater pumps driven through American Blower adjustable-speed Gýrol Fluid Drives.

Savings are threefold:

1. Shaft-end pumps eliminate costly electrical accessories necessary for motor-driven feed pumps.

2. Auxiliary demands are reduced, so more power can be released to consumer lines.

3. American Blower Gýrol Fluid Drive saves power over the entire operating range. It offers adjustable-speed pump control that eliminates wasteful throttling; reduces wear by operating pumps at speeds to fit boiler demands.

In addition, paralleling of pumps is simplified with Gýrol Fluid Drive. Emergency changeover from operating to standby pump is easily accomplished.

Let an American Blower sales engineer show you how Gýrol Fluid Drive can save power, cut costs . . . improve operating efficiency. Contact our nearest branch office, or write: American-Standard,* American Blower Division, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

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Selected over 12

These lighting fixtures can be moved as easily as the office partitions.
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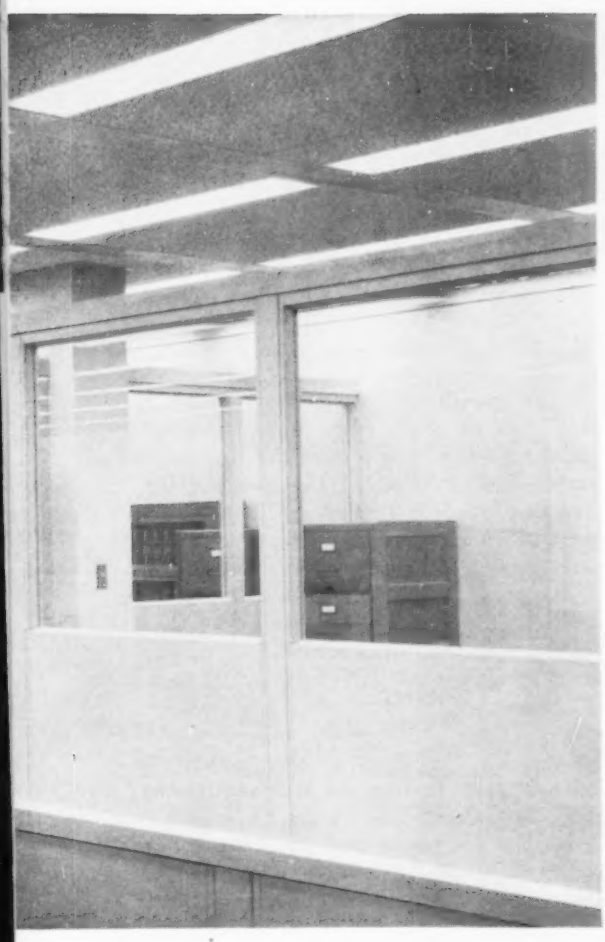
PROOF! No "or equal" can match Day-Brite!

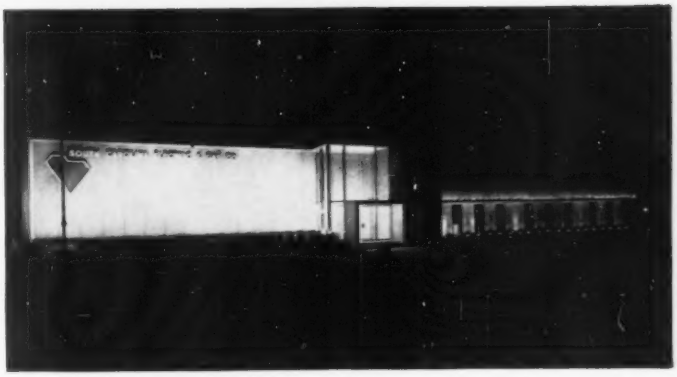
Twelve different competitive fixtures were installed on a test basis in the new home of the South Carolina Electric and Gas Co. The architect and client each compared the fixtures *independently*, and both chose Day-Brite Troffers for the entire job.

Make your own comparison. Call your Day-Brite representative, listed in the Yellow Pages, for a demonstration. Compare Day-Brite fixtures side-by-side with any other fixtures at any price. Check features and value. Prove to your own satisfaction that Day-Brite fixtures have no "or equals."

Additional light where it is needed!
Extra row of Day-Brite Troffers above business machines (next to wall) provide 85 footcandles at work level.

competitive fixtures!





South Carolina Electric and Gas Co., Columbia, South Carolina.
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How Modular Lighting by Day-Brite helps Engineers LOWER CONSTRUCTION COSTS

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Interchangeable with acoustical ceiling panels, they enable you to take full advantage of all the economies made possible by modular construction.

For more information on how Day-Brite equipment can help you coordinate lighting with ceilings in appearance, function and assembly, write for your copy of free booklet: "*Modular Lighting for Modular Measure.*"

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NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT

Report From The East Coast

STAFF

THE NEW JERSEY LEGISLATURE will not be the same after the New Jersey Society of Professional Engineers' recent annual convention in Atlantic City. A large number of legislative topics, ranging from the state's water supply to the amount of the registration fee, highlighted the agenda.

For the Society, perhaps the most significant aspect of the meeting was the role played by the 103-member Consulting Engineers Functional Section. This group, formed only a few months ago, already has helped prevent passage of a number of bills considered harmful to the engineer.

This stopgap action was the result of an unusual situation. NJSPE had planned to check legislation during the current session, but communications broke down. The executive director regularly notified the president of the current status of all bills. The president read the reports, but assumed that if any action was necessary, he would be notified by the head of the NJSPE legislative committee (who also is an assemblyman). Meanwhile, the legislative committee head also watched the proceedings with interest. He assumed that if any action was desired by NJSPE, he would be notified.

Functional Group Active

The mix-up was discovered when the functionals started inquiring about current legislation, and the members were asked to take any action as individuals that they thought necessary. Here is what they accomplished:

¶ At the request of the functional section, a bill that would have created a mechanical engineering board – without any engineers as members – was stopped momentarily and will be redrafted before being resubmitted. Joseph Rosenthal, functional group chairman, said the original bill would have allowed the mechanical engineering board it created to pass on power plant and compressed-air equipment designs. (At present the Mechanical Engineering Bureau of the N.J. Department of Labor & Industry only is responsible for licensing stationary engineers and firemen.)

¶ Functional group members also are concerned because mechanical designs are not considered "as part of the building" under current New Jersey law. As a result, mechanical design is not among the portions of a building that must be designed by an engineer or an architect. Further, no one inspects the mechanical work to see that it is done properly. Rosenthal said a meeting was held two months ago with the N.J. Department of Labor & Industry regarding the necessity for having an engineer's seal on original designs of such installations. The functional group will seek NJSPE support to require the seal of a licensed engineer on all mechanical plans.

¶ Rosenthal also reported that a bill, passed by the Assembly and now pending before the Senate, raises New Jersey engineering licensing fees (application fee plus first year registration) from $20 to $40, and from $30 to $50 for a combination engineering-surveying license. This is a marked difference, particularly since at present, anyone applying for a license and not meeting all requirements forfeits the fee. Rosenthal said he understands an agreement has been made with the Licensing Board to waive fees for a candidate who is reapplying and has paid once. This agreement will be necessary only until licensing laws are revised.

¶ A bill allowing unlicensed persons to do engineering on their own property was passed by the legislature. Members raised the question of what would happen if an inexperienced person did his

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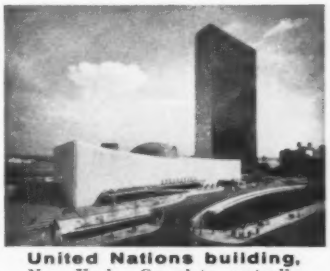

United Nations building, New York—Complete centrally supervised security system: fire alarm, smoke detection, and watchmen's call-in systems with central control.

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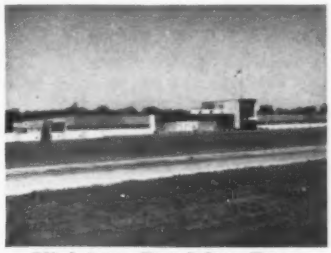
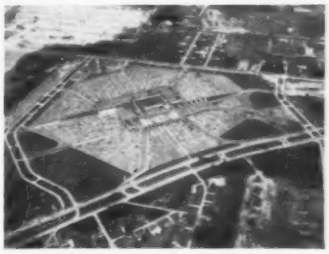
Texas Technological College, Lubbock, Texas—Edwards return call system with wire-saving exclusive simplified circuit, serving 732 dormitory rooms.



Miniature Precision Bearings, Inc., plant in Keene, New Hampshire—Edwards clock and program system; city-connected low-voltage fire alarm system, with automatic detectors, providing 24-hour protection.



Northland Shopping Center, Detroit, Michigan—Edwards silent visual-paging system installed at The J. L. Hudson Co. store.

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own engineering, then sold the property within a short time. Seeing "certain weaknesses" in the bill, the functional section will discuss the bill with state authorities.

¶ The functionals also delayed a bill that would have created a Commission on Radiation Protection in the Department of Health. The engineers felt that the bill should provide for at least two engineers on the proposed five-man board responsible for preventing harmful radiation. They also suggested the bill should require registered engineers to inspect and approve all engineering aspects of any projects involving radiation.

¶ Further complaints were voiced about a bill (killed in recent legislative sessions) that would have set up a Bureau of Engineering and Safety and an Industrial Accident Prevention Board, in the N.J. Department of Labor and Industry. The new boards would have been, in effect, appeal boards for engineers who could not gain approval of the Department of Labor and Industry for their plans. Comprised of laymen, these boards would have meant long delays in getting plans approved. Rosenthal pointed out that the Department already has a three-man appeal board.

¶ A functional section committee also is studying legislation which currently allows architects to file an "intent of lien," but does not give engineers the same privilege.

¶ It was pointed out that there is no board to judge existing rules concerning building codes, plumbing in particular. Opinions differ about the definition of an "engineering project" requiring the seal of a professional engineer. The functionals voted to request the NJSPE to reactivate a former building code committee to help persons "interpret" the codes.

¶ The New Jersey Licensing Board currently does not announce the names of persons found guilty of violations of the registration laws or rules of ethics. However, the Board has fined some persons $200 for violations. The functional section is sending a letter to the board requesting future violations be made public, as an added incentive for New Jersey engineers to observe the laws.

Actions of the Delegates

At the delegates' meeting, a motion requesting immediate action to build an adequate higher education system in New Jersey was tabled. Delegates pointed out that the "adequate higher education system" was not defined, and there was no mention of how the system was to be financed.

The delegates endorsed a water development program, up for referendum in November, because New Jersey's present supply is inadequate and a new supply is needed immediately.

Delegates unanimously asked the legislature to delay action on a proposed licensing bill (in its present form) for professional planners. Some pointed out that the bill

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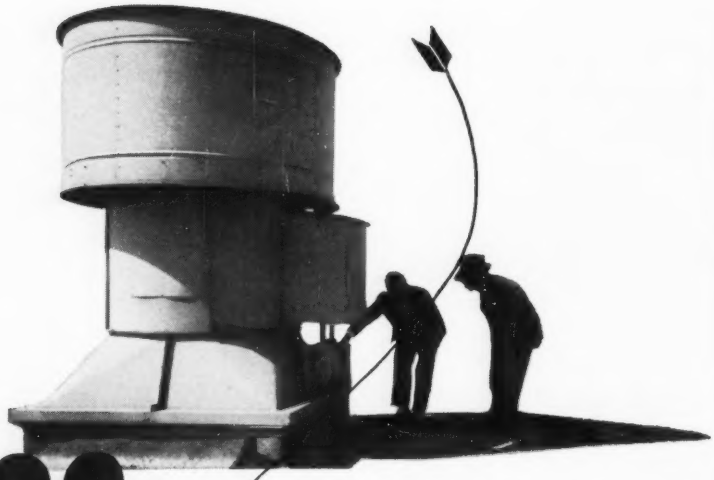

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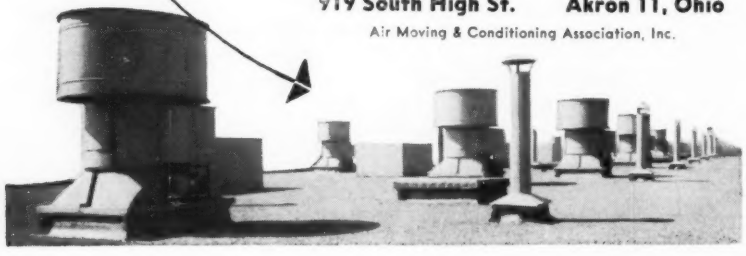


"would make it most difficult for those most qualified to be licensed." Under a grandfather clause, a youth who had worked continuously for a professional planning office could get a license, yet a qualified planner who had been doing this type of work for 15 years on a part-time basis would have trouble getting one. The delegates voted to talk over their objections with New Jersey architects and planning groups.

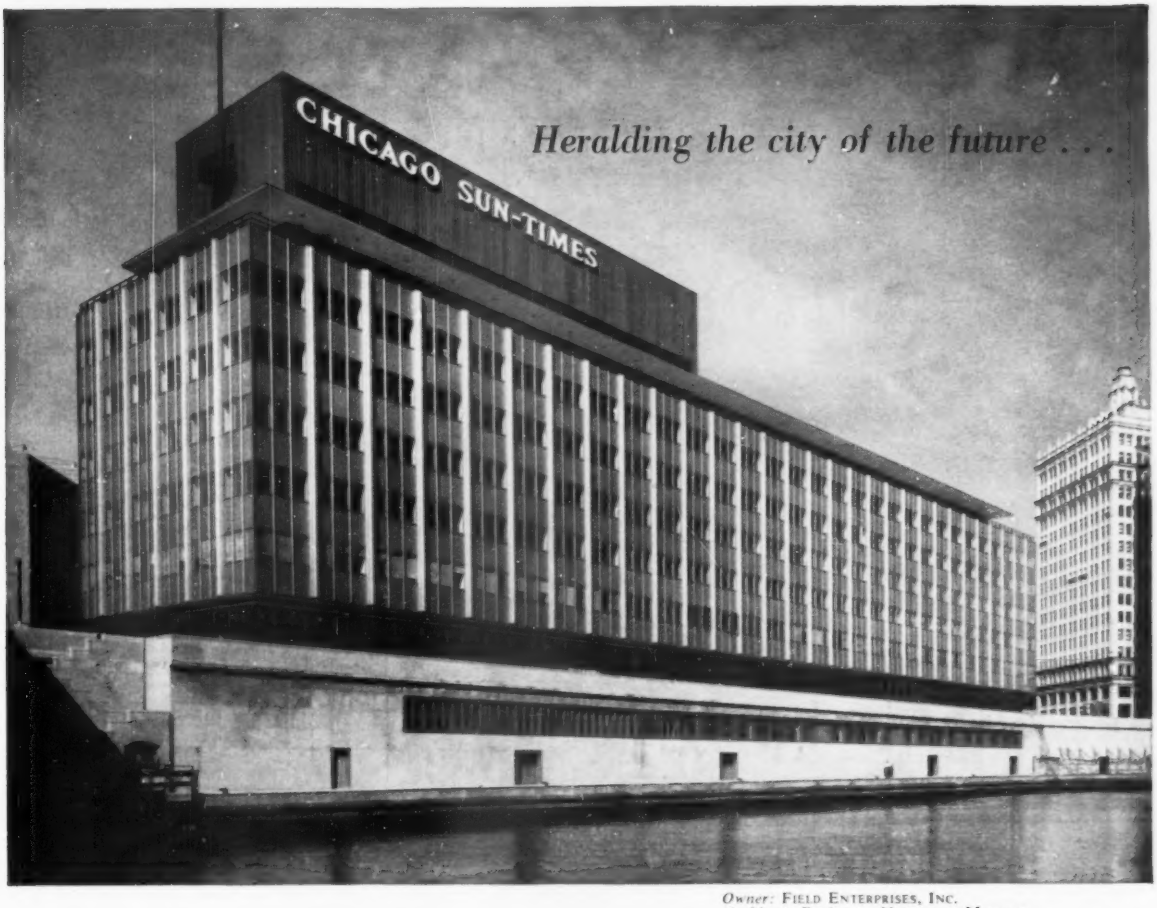
After discussing the inadequate mass transportation between New Jersey and other states, the delegates voted to recommend that an interstate committee be appointed to study the problem, and urged that legislation be passed to remedy the situation.

Licensing and the unauthorized use of the term "engineer" came up for much talk. A resolution was passed requesting the ethics committee to investigate rumors that several state departments are hiring unregistered engineers to do engineering work.

A committee reported that some New Jersey architects use seals of engineers who work from their homes on a part-time basis. One engineer said he knew of one instance where an engineer's name and seal had been put on a drawing while the engineer was vacationing in Florida.

Some New Jersey contractors term their firms contracting-engineering organizations, yet they have no registered engineers on their staffs. The functional section is sending such "suspect" firms letters requesting the name of the registered engineer in the organization. Any violations discovered will be turned over to the NJSPE board which, in turn, will notify the State Licensing Board.

Members were told "the Society is diligently trying to strengthen the corporate practice law a little at a time. The present proposal is to have all registered engineers with corporations report or be reported yearly to the State Board.



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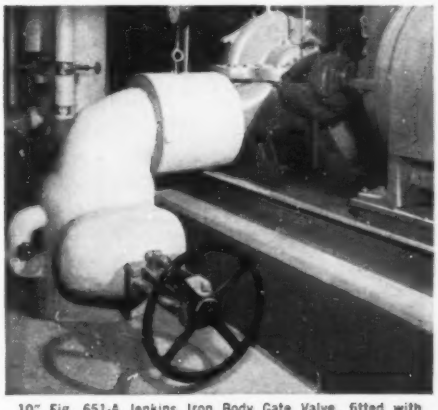

10" Fig. 651-A Jenkins Iron Body Gate Valve, fitted with by-pass, on suction line of pump which supplies Chicago River Water as condenser water and process water for type foundry requirements.

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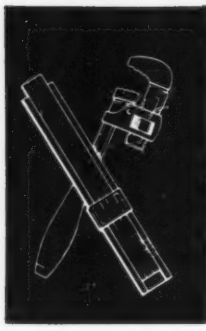

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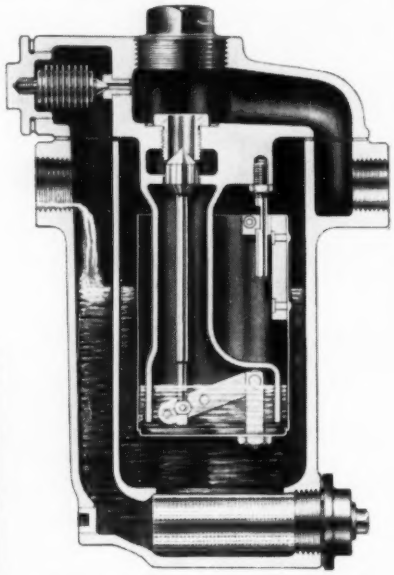

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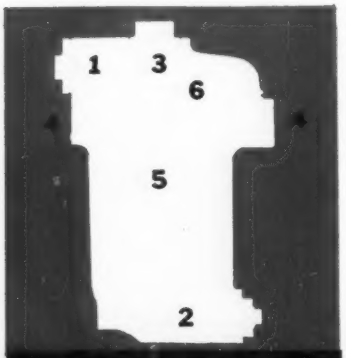

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With this provision, all corporations practicing engineering will automatically be required to have licensed men who are responsible for the engineering work."

Ethical problems came up. Rosenthal said the ethics committee will look into cases where a firm makes plans as a consulting engineer, then bids on them as a contractor. The ethics committee also is concerned with "free engineering" and will try to eliminate it with "moral pressure."

The functional section was more definite about competitive bidding. Members were asked to report such cases to the section, which would recommend a course of action to the NJSPE Board.

The functional section requested that at least one member be named to the NJSPE committee on ethics.

Other Recommendations

Convention delegates also considered these items:

¶ The governor appoints persons to the State Licensing Board on NJSPE recommendation. The suggestion that only past and present NJSPE officers be recommended for the board was referred to the ethics committee.

¶ The operational committee reported no group errors and omissions insurance, with a discount, could be found for New Jersey.

¶ The Manual of Professional Practice omits any mention of payment for engineers appearing before public and private groups on zoning matters. Rosenthal suggested this be included next time the Manual is revised.

¶ The functional section reported that it is compiling a roster of New Jersey consulting engineers. This project was undertaken at the request of the National Society of Professional Engineers Functional Section, as part of a nationwide program. The group agreed to supply such a list, at the suggestion of President W. Earl Christian, provided the list "is not used to negate recruiting efforts." ▲▲

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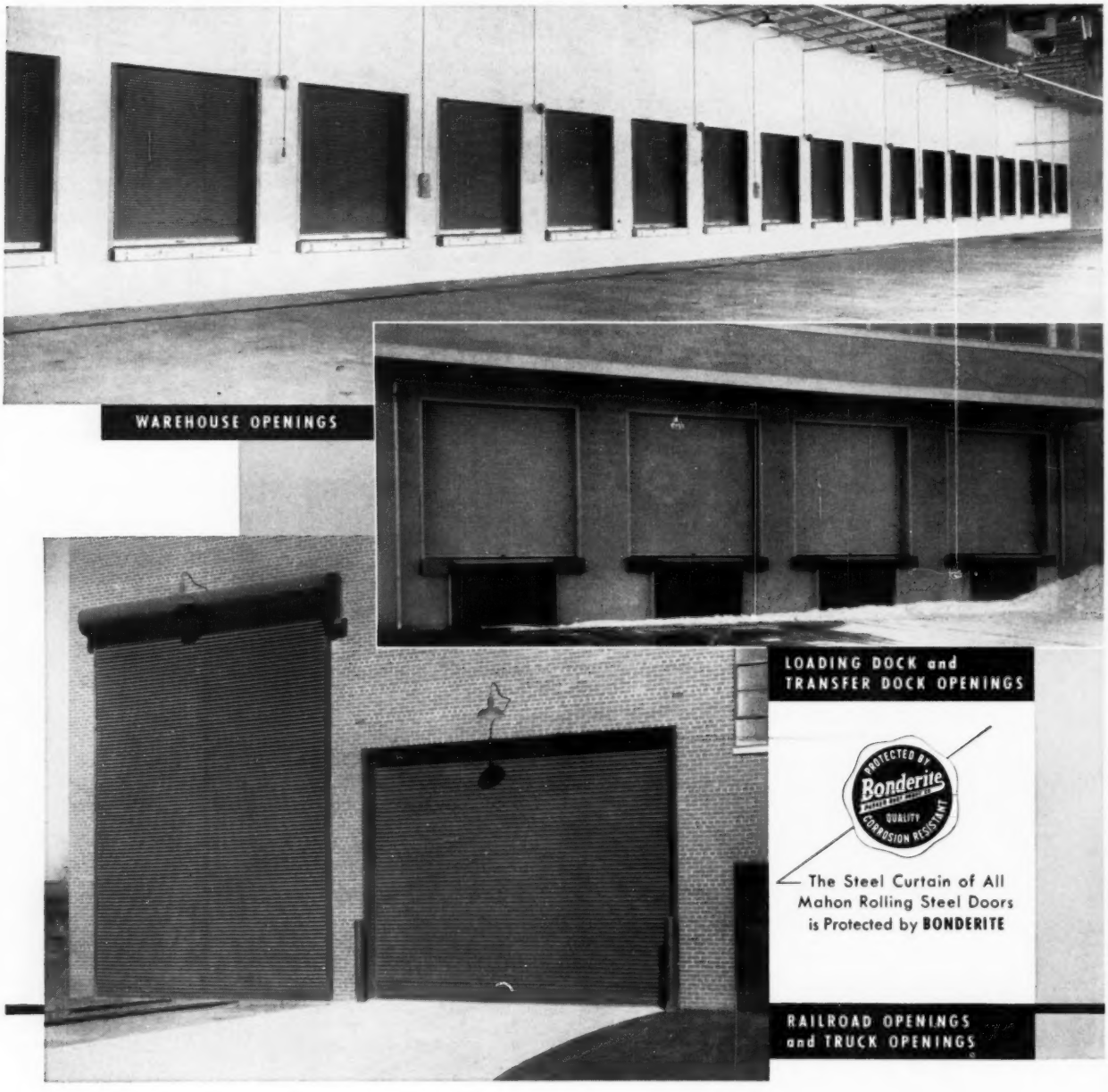

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Teplo-Elektro-Proyekt Institute plans two zones to supply power in European Russia. The first zone comprises the center, the south, the Volga basin, and the Urals. At present this zone is covered by three large power systems – the Central, the Southern, and the Urals grids, with a combined power of 30-million kw. Linked by high-voltage supply lines from the Volga power stations, these grids will provide the background of the new system. Power will go to Arzamas, Ryazan, Tambov, Balashov, and Voronezh provinces, and Mordva, Tartar, and Bashkir autonomous republics. A 400-kv transmission line will link the Votkinsk hydroelectric station on the Kama with Sverdlovsk, and another line will connect the Kremenchug hydroelectric power house with Kiev.

The second power zone encompasses north and west Russia. Here, at present, are the Leningrad, Estonian, Latvian, Lithuanian, Kaliningrad, and Belorussian power grids. Two – the Leningrad and Estonian grids – are linked by the Narva hydroelectric station, and will be linked with the Baltic and Belorussian systems. Thus a unified northwest power system will be linked with other systems of European Russia, covering an area of 1.5-million square miles – one-fifth of the USSR. The single power system for European Russia will be completed by the end of the current five-year plan (1960) and will generate half of all Russia's electricity. The over-all program to link European and Asiatic Russia will take 15 years.

To look at the proposed Soviet unified electric power supply system, it is necessary to examine the key power stations.

The Kuibyshev hydroelectric station has been supplying, for two years now, electric power to Moscow over one of the longest transmission lines in the world. This line has a capacity of 1.2-million kw at 400 kv. Another 400-kv line from Kuibyshev to the Urals is under construction. Over 650-miles long, the line will be put in operation by 1960. These lines going through Kuibyshev will provide a direct link between the Central and Urals grids.

The Stalingrad station will provide a similar link between the Southern, Central, and Urals grids. The Stalingrad hydroelectric station is still under construction; it will be larger than the Kuibyshev station.

One 600-mile link connecting the Stalingrad station with Moscow will pass through Balashev, Lipetsk, and Ryazan provinces. Three substations will provide power to Balashev, Gryazy, Michurinsk, Mikhailov, and Kashira. Over 11,000 miles of cable will be hung from 5000 metal pylons. The line will carry 1.5-million kw at 400 kv.

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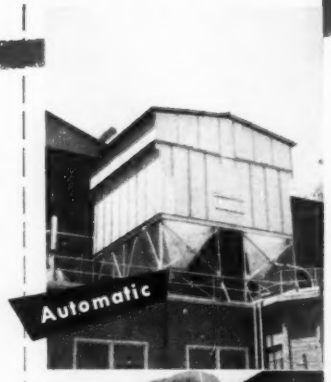

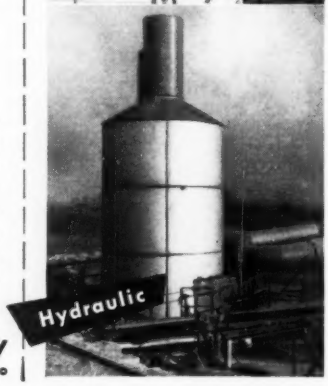

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Norblo ENGINEERED DUST COLLECTION SYSTEMS FOR ALL INDUSTRIES

longest high-voltage transmission line, covering the 200 miles between Gyumush and Tatel, was completed a few months ago.

Beyond the Urals, in Siberia, a single power system will embrace a vast area from Novosibirsk to Irkutsk. Transmission lines of 400 kv will connect the Bratsk power station with the Irkutsk and Cheremkhovo grids, and with the Krasnoyarsk hydroelectric station on the River Enisei; the latter will in turn be linked with big thermal power stations in the Kuzbas coal basin. The 400-mile high-voltage line between Irkutsk and Bratsk hydropower station will carry 3600 kw. Finally, the Siberian grid will be linked with the Urals and thus with the European network. The high-voltage lines between Siberia and the Urals will be almost 4000-miles long. One, linking Enisei and the Urals, will be 1250-miles long.

Plans are afoot for a power system linking Uzbekistan, Tajikistan, and southern Kazakhstan and Kirghizia. In the far north, a 100-kw power transmission line 180-miles long will supply electricity to Indigirka mines.

Most of these lines are intended to carry 400 kv, but research and planning institutes, as well as the electrical industry, already are thinking of transmission lines carrying 600 or 700 kv.

Australian Steel Mill

The South Australia government and the Broken Hill Proprietary Co. are planning a steel works at Whyalla. The 68-million installation will include rolling mills and associated plants. Construction will begin in 1960.

Jet Airport Under Construction

Qantas Empire Airways is starting a $7.5-million terminal at Mascot to provide facilities for jet airliners due for delivery in May 1959.

Solar Distillation

The pale Antarctic sun is operating a solar still to transform salt wa-

ANNOUNCING THE WEIL-McLAIN No. 82

OIL FIRED BOILER AND OIL HEATING UNIT

I=B=R tested and rated for capacities of 1300-3260 sq. ft. steam and 2255-5290 sq. ft. water

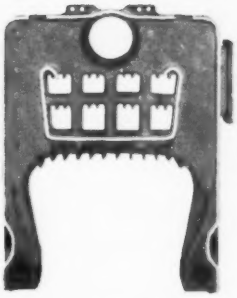
A genuine advance in boiler design...offering new features for operating economy, easy maintenance, simplified erection and long life!

The No. 82 Boiler incorporates the self-regulating, turn-around principle of flue gas travel developed by Weil-McLain engineers for increased heat transfer and greater fuel economy.

Other features include a new asbestos rope seal...a pre-cast refractory combustion chamber designed to properly develop the full heat potential of the burner flame...an electronic safety control to prove the flame in No. 82 Boilers burning 7 GPH and up...top clean-out plates for easy access to all surfaces...and short draw rods which simplify erection and assure a strain-free boiler assembly.

PROVISION FOR SINGLE OR DUAL WATER HEATERS

The Weil-McLain No. 82 Boiler has a unique and exclusive method of installing tankless water heaters. The diagram below shows how either single or dual heaters can be employed. The fin tube heater itself is a highly efficient unit of large capacity.

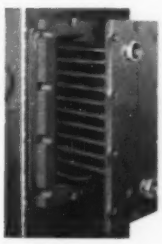


ASBESTOS ROPE SEAL

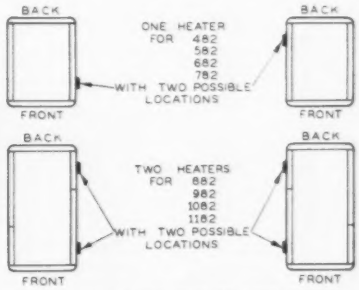
Exclusive! Asbestos rope inserts in grooved seal strip in boiler sections. Compressible —won't crack or squeeze out ...remains gas-tight during life of the boiler.

SELF-REGULATING FLUE GAS TRAVEL

Ingenious design of sections breaks flue gases into multiple streams which contact all heating surfaces to top of sections...greatly increases heat transfer.



TANKLESS WATER HEATER



IF ONLY ONE HEATER IS TO BE USED ON 882 THRU 1182 ANY ONE OF THE FOUR POSITIONS INDICATED ABOVE MAY BE USED

Send for bulletin giving complete description and engineering data

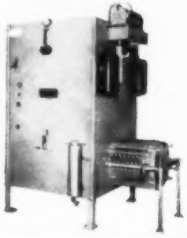
WEIL-McLAIN BOILERS · RADIATORS

WEIL-McLAIN COMPANY
MICHIGAN CITY, INDIANA

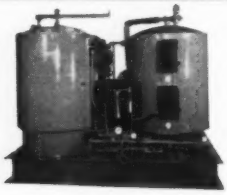
Address literature requests to Dept. DD-68

You get longer machinery life, lower maintenance costs with HILCO OIL MAINTENANCE EQUIPMENT

OIL RECLAIMER
For continuous oil purification in range of 2-100 gph. Removes all solids, acids and volatile contaminants.



PURIFIER-RE-REFINER
For all purification in batches of from 6 to 100 gallons. Removes all solids, acids and volatile contaminants.



HIGH CAPACITY RECLAIMER
Combines filtration for removal of solids and sludge with vacuum vaporization for removal of solids, acids, water, solvents, fuel dilution. Furnished in standard or custom built models to 600 gph.

FILTER
Furnished in capacities from 0.1 to 750 gpm. Various cartridges available for mineral and inhibited detergent oils.

Whenever oil is used it becomes contaminated and must be discarded or conditioned for further use. There is a HILCO to do this job for you. HILCO offers a wide range of oil purification units to meet every oil conditioning problem . . . stationary or portable. You can recover large quantities of oil at low cost. HILCO units are available for continuous or batch operation. And HILCO purification means complete oil purification.

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- Diesel Engines
- Trucks
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ter into fresh for the Australian Expedition. The compact still can produce small quantities of purified water in any climate at very low cost.

About two gallons of purified drinking water are produced daily by the still, which can be set up in 30 minutes, and even can be dropped by parachute.

Water for Ankara

Ankara, Turkey has allocated $62.4 million for a Sakarya River water project. To be completed in 5 years, the project calls for construction of 60 miles of pipeline, with pumping stations, filtration plant, and storage reservoirs. Water will be brought from Sakarya and Porsuk Rivers to Ankara.

The system will supply the city with 335,000 tons of water a day, which should meet its needs for 60 years.

Improved Canals in Egypt

The Egyptian Ministry of Public Works has announced a 10-year $14.4-million program for improvement of the nation's domestic waterway system.

Included in the program are construction of new canals, and extension, widening, and deepening of existing canals throughout the Delta and upper Egypt, as well as the creation of about 50 new river and canal ports and anchorages.

Among specific projects is improvement of the water route between Cairo and Alexandria by extending and deepening its components, reducing freight transit time from 10 to 5 days.

Mexican Roads

Mexican federal and state governments place great emphasis on new roads to connect the country's interior towns and valleys with the principal highways, and on paving and completing the main coastal highway network.

The federal government has earmarked $1.9 million, and Veracruz state $500,000, for work on

NOW is the time to REDUCE COSTS

COSTS CAN BE REDUCED IN SEVERAL WAYS ELECTRICALLY

Higher voltage distribution transmits more electric light and power with smaller lines more efficiently, and provides better voltage regulation.

Reduce wiring costs by installing SORGEL dry-type transformers at load centers to step down voltage to utilization voltage so that shorter secondary feeders can be used — in new building and modernization projects.

ALL Sorgel dry-type transformers are so quiet that they are adaptable for any indoor installation — in institutional, commercial, and industrial buildings. They do not require fire-proof vaults, nor any other enclosures.

Available in all standard and intermediate ratings, ¼ to 10,000 Kva, 120 to 15,000 volts.

SORGEL transformers, either dry-type or Askarel-cooled, are also incorporated in substations. They are procurable with any type or make of switchgear, and from any substation manufacturer.

Electric power for various manufacturing processes can be regulated and controlled more efficiently with SORGEL saturable reactors. Any amount of A.C. power from 1 Kva to 3000 Kva, single phase or 3-phase, at any voltage, can be controlled, regulated, and varied in stepless increments, either automatically or manually.

The control can be a small manually operated hand wheel that can be placed in any desired location, or the power can be automatically controlled, regulated and varied by a thermostat or any other instrument or device.

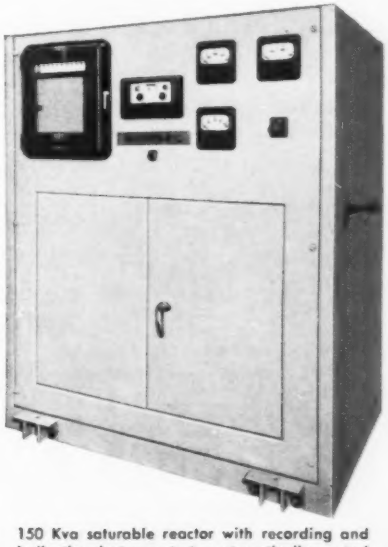
Some typical applications for SORGEL saturable reactors are: controlling and regulating the temperature of electrical furnaces, ovens, metal melting, glass melting, heat treating, dimming incandescent and infra-red lamps, and various chemical processes.

SORGEL saturable reactors are designed to meet your exact requirements. Let us know what your requirements are, and we will submit our recommendations with complete information.

100 Kva single phase dry-type transformer

For more information contact the Sorgel Electric Company, or consult the classified section of your telephone directory for our nearest sales engineer.

SORGEL TRANSFORMERS

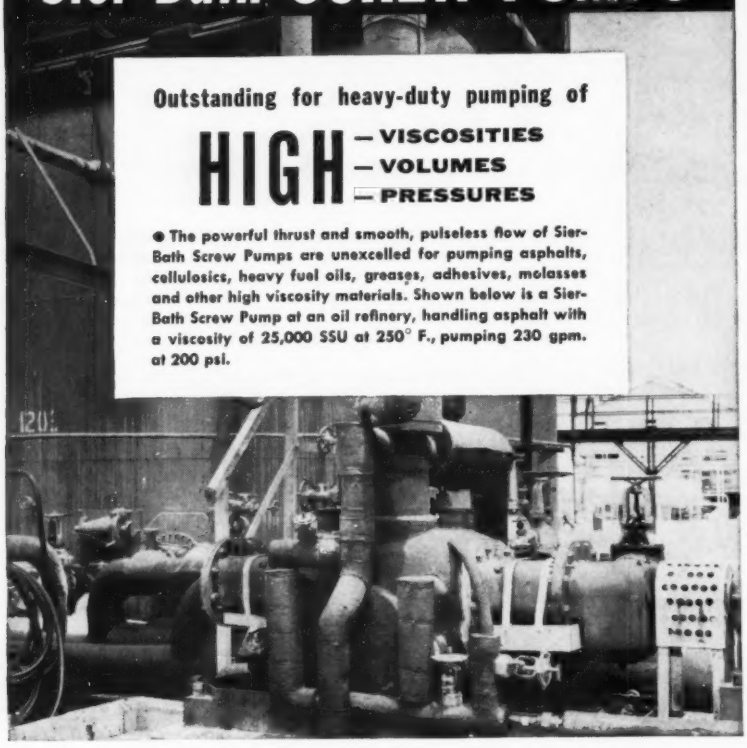


150 Kva saturable reactor with recording and indicating instruments to automatically control the temperature of the heat treating equipment.

SORGEL ELECTRIC CO., 843 West National Avenue, Milwaukee 4, Wisconsin

40 years' experience in the development, manufacturing and application of transformers

Sier-Bath SCREW PUMPS

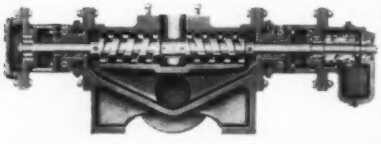


Outstanding for heavy-duty pumping of

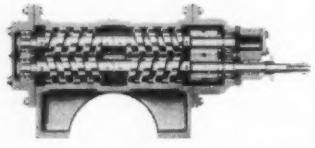
HIGH — VISCOSITIES
— VOLUMES
— PRESSURES

● The powerful thrust and smooth, pulseless flow of Sier-Bath Screw Pumps are unexcelled for pumping asphalts, cellulosics, heavy fuel oils, greases, adhesives, molasses and other high viscosity materials. Shown below is a Sier-Bath Screw Pump at an oil refinery, handling asphalt with a viscosity of 25,000 SSU at 250° F., pumping 230 gpm. at 200 psi.

Sier-Bath SCREW PUMPS



External Gear and Bearing Bracket Type for non-lubricating liquids and semi-liquids



Internal Gear and Bearing Type for lubricating liquids and semi-liquids

Sier-Bath Screw Pumps maintain high volumetric efficiency because "Dual-Controlled" precision rotor design prevents rotor-to-rotor or rotor-to-casing contact—provides a continuous flow without pulsation, hammering or vibration . . . without strains, misalignment and wear on rotors, shafts, bearings and gears.

Result: Dependable, uninterrupted pumping service—less maintenance—easier servicing—longer pump life—lower overall pumping costs.

Capacities from 1 to 2,000 gpm.; viscosities from 32 SSU to 1,000,000 SSU.; discharge to 1,000 psi. for viscous liquids, 200 psi. for water and light oils. Horizontal or vertical construction. Corrosion resistant alloys, special bodies, stuffing boxes and bearings for special needs. See "Yellow Pages" for your Sier-Bath representative or write Sier-Bath Gear & Pump Co., Inc., 9257 Hudson Blvd., North Bergen, N. J.

Sier-Bath ROTARY PUMPS

Screw Pumps | Gearex® Pumps | Hydrex® Pumps

Founded 1905 | Mfrs. of Precision Gears, Rotary Pumps, Flexible Gear Couplings | Member A. G. M. A.

13 new roads to serve rich agricultural areas, bringing them closer to available markets.

The government has set aside $1.2 million to finish a highway between Salina Cruz on the west coast and Coatzaccalcos on the east coast. This road is one of the major highways in Mexico.

Construction has begun on a $650,000 bridge across the Panuco River in the Huasteca region. Another bridge, this one costing $1.1 million, will span the Lake of Alvarado. This project will take at least 5 years to complete.

Italian Airport Construction

Work has begun on Venice's new Marco Polo International Airport, another step in Italy's airport-construction program.

The new field, to cover 320 acres, will cost $5.6 million. The main runway will be 7900-ft long and 200-ft wide. Marco Polo is expected to handle the largest and fastest commercial planes coming into operation in the next few years.

Other Italian airport projects include Genoa, Palermo, Cagliari on the island of Sardinia (which also serves as an alternate for Rome), and Rome, now building an airport at Fumicino to replace Ciampino.

Although nothing concrete has developed so far, Milan is considering replacing Malpensa.

In addition, several of Italy's lesser fields, including those at Turin and Brindisi, have been enlarged and modernized in the past several years.

Japan Undersea Tunnel

A 2½-mile undersea highway tunnel connecting the Japanese islands of Honshu and Kyushu was opened in March, marking a milestone in the Japanese civil engineering construction industry.

The new Kanmon tunnel runs between Shimonoseki at the southern tip of Honshu and Moji, the northern terminal of Kyushu.

The tunnel is the world's second-longest underwater tunnel

Frank J. Schwemler, Commissioner of Water
Consulting Engineers—Havens and Emerson
Prestressed Concrete pipe by Price Brothers

Cleveland...

...uses Pratt Valves in a tight spot

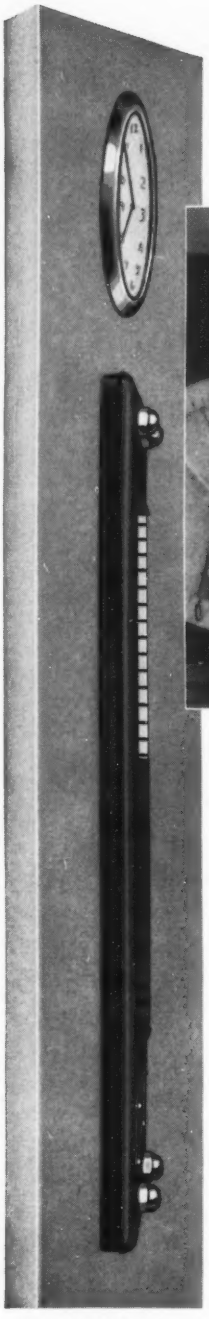
City installations, with limited clearances and traffic problems, are never easy. This Cleveland project, tying a new booster station into two distribution lines, is about as tough as they come.

Here the specifications could not call only for "dependable valves" . . . it had to be "*dependable valves that are easy to install.*" This is where the engineer and contractor can tap the benefits of Pratt's long experience . . . major features of Pratt Butterfly Valves include exactly those things that simplify difficult jobs: minimum head room, versatile operators that can be buried without vaults . . . and design and construction such that the valve will always be easy to open or close.

If you would like to know more about Pratt Butterfly Valves, 40 page manual B2J is yours for the asking. *Henry Pratt Co., 2222 S. Halsted St., Chicago 8, Ill.* Representatives in principal cities.

HENRY PRATT

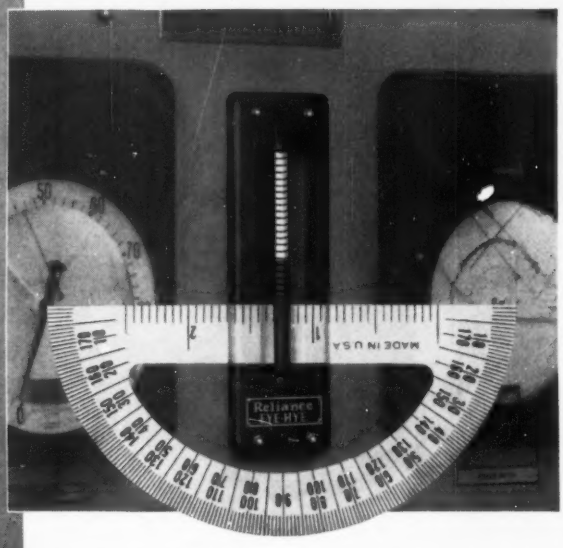
RUBBER SEAT Butterfly Valves



The EYE-HYE can be equipped to actuate additional signals — lights or horns — to warn operators if dangerously low or high levels occur.

New Reliance EYE-HYE

gives you 180° reading of boiler water levels



Bright green-white image *clearly visible* all around your control room

Wherever you stand in front of your panel — even 90° from center, either side — you can read the picture in EYE-HYE's new protruding window. The brightly illuminated green indicating fluid that spells "water" contrasts sharply with the upper white (steam) section. A new lighting principle brings extra carrying power to the image.

There's no change in the dependable manometric gage principle of operation. EYE-HYE still retains its original simplicity, successful for over 20 years. Thousands of operators prefer the familiar liquid column indication, as in conventional water gages . . . Models are available for any working pressure up to 2500 psi. Write for catalog information — mention your pressure.

The Reliance Gauge Column Co.
5902 Carnegie Ave. • Cleveland 3, Ohio

(the longest is the 15,044-ft Mersey Tunnel linking Liverpool and Birkenhead in Britain), and is the first of its kind in the world. The underwater part has double decks with motor traffic lanes on the upper deck and a pedestrian passageway on the lower.

Before the highway tunnel was completed the only connecting tunnel was Kanmon Railway Tunnel, completed in 1944, running parallel to the new tunnel. Construction of Kanmon Highway Tunnel was begun in 1937 but was suspended for 8 years from 1944 to 1952.

For some time the Japanese have conceived a plan for linking their main islands by bridges or undersea tunnels. Projects under study are the Tsugaru Strait undersea railway tunnel and bridges to link Honshu, Hokkaido, and Shikoku.

The railway tunnel to link Honshu and Hokkaido, according to Japan National Railways preliminary design, would be some 25-miles long, over 10 times the length of Kanmon Highway Tunnel, or nearly double the Simplon Tunnel, the world's longest (12.5 miles) tunnel connecting Switzerland and Italy, under the Alps. Construction is estimated to cost $168 million, and would require 10 years.

A plan for bridging Honshu and Shikoku via Awaji Island also is being studied currently. According to the preliminary plan, Akashi Bridge, linking Honshu and Awaji Island, would be 3-miles long, and Naruto Bridge, linking Awaji Island and Shikoku, 1 mile. Both bridges would be 100-ft wide and double tracked, with lanes for vehicles and sidewalks for pedestrians on both sides. Construction is estimated to cost $11.1 million and take 10 years to complete.

Thames Tunnel

The longest road-river tunnel constructed in Britain since the Mersey Tunnel was completed in 1934 should be ready for traffic in 1962. The new Thames tunnel will link Essex and Kent counties on op-

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Curtis

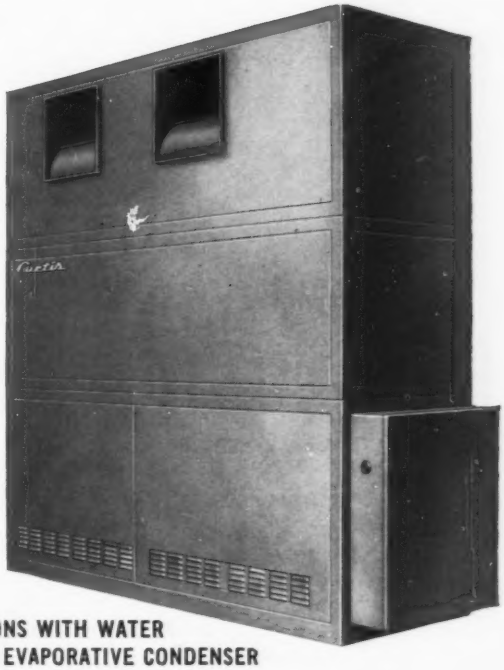
PACKAGED AIR CONDITIONING

INSTALLATION EASIER: Line assembled at the factory —eliminates expensive field labor.

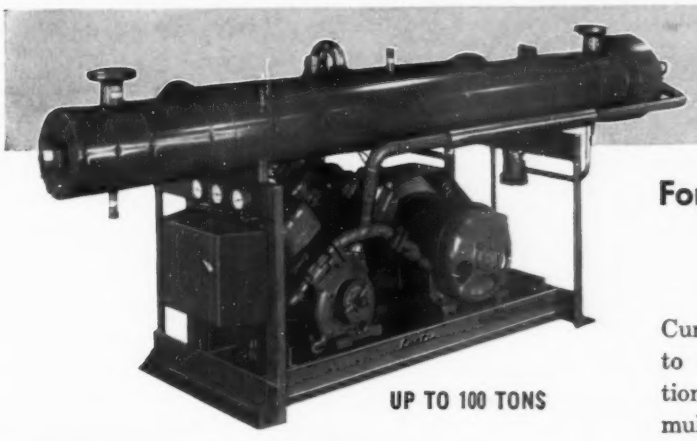
PERFORMANCE KNOWN: Curtis units are run-in at the factory and guaranteed to deliver their rated tonnage. Assures a BALANCED SYSTEM.

SUPERIOR EQUIPMENT: Long life, quiet, trouble free, economical operation.

DELIVERY ON TIME: Curtis can meet your delivery requirements, a decided advantage over multiple supplier delivery promises!



UP TO 50 TONS WITH WATER COOLED OR EVAPORATIVE CONDENSER



UP TO 100 TONS

PACKAGED LIQUID CHILLERS

For Air Conditioning Process Cooling Refrigeration

Curtis packaged liquid chiller lends itself to a widely diversified field of applications—air conditioning, refrigeration and a multitude of process cooling procedures. Available in capacities up to 100 tons.

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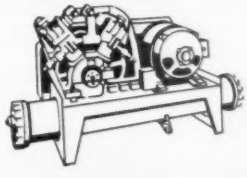
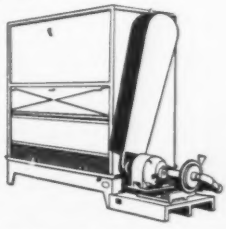
Air Cooled Air Conditioning Units, 3-5-7½ tons. Residential and commercial application.



Condensing Units up to 100 tons.



Cooling towers and evaporating condensers, air handling units to match.

C-33

Represented in Canada by—T. M. Hall Ltd., 30 Milner St., Montreal West 28, P.Q., Canada

Atomic submarines and family ties

by A. G. Schifino

Nuclear-powered subs are the product of one of America's greatest industrial families. If you're like most of us, you have a healthy respect for those who can design and build such marvels. And you may very well want to know another member of this same family – a member who makes equipment important to you in your practice.

Stromberg-Carlson is the fast-growing electronic arm of the great General Dynamics family, a corporation which has to its credit such triumphs of science and engineering as the Nautilus and its sister ships . . . the Atlas ICBM . . . the supersonic B-58 . . . jet airliners . . . and more.

At Stromberg-Carlson we design and manufacture – among many other things – sound communication systems for commercial, industrial and institutional buildings. *In your professional capacity you are frequently concerned with such equipment when you write specifications.* When you specify sound equipment, we'd like you to consider Stromberg-Carlson's. And for many good reasons.

First, you'll be dealing with a company that has behind it the vast resources of one of America's most progressive industrial giants.

Then there's our own background in communications. We've been in this business since 1894. We've pioneered and marked out trails that others are following. All our experience and know-how is poured into the sound systems we present for your consideration when you write specs.

But quality by itself is only half a loaf. Other manufacturers make fine products, too. What constitutes the other half?

Well, we've already mentioned a couple of general points. Now for some specifics:

1. Our factory engineering staff is always at your service to cooperate in writing specs.
2. Our men in the field are quickly available when you need them.
3. Our distributors are located in all major cities, covering all parts of the country. These distributors are also ready and willing to give you all the cooperation you need.

It goes almost without saying that the right kind of sound communications system is an integral part of any modern commercial, industrial or institutional building. We think you'll be doing your clients a favor by specifying systems by Stromberg-Carlson.

I've collected a lot of case histories of sound installations that you should find quite provocative. They range from bowling alleys to the world's largest insurance company. If you drop me a line, I'll be happy to send you this collection. Ask for the "Case File."

In addition, the Stromberg-Carlson distributor in your area will gladly supply all the data you want on our equipment and services. You'll find him in the Yellow Pages of your telephone book under "Public Address and Sound Equipment."

A. G. Schifino

Vice President
Special Products Division
STROMBERG-CARLSON
A Division of
General Dynamics Corporation
Rochester 3, N. Y.

posite sides of the Thames Estuary, about 15 miles below London.

More than 730 feet of the main tunnel has been completed since the $30-million project was started again a year ago, after having been held up by World War II.

Powerful hydraulic rams are pushing two 300-ton shields toward each other from the Essex and Kent banks. The two shields trim the edges of the 28-ft diameter tunnel. Cast-iron rings behind the shields form the 34,000-ton structural lining. Tunnel pressure is kept between 25 and 27 psi to prevent water entering.

New Canadian Power Project

Early completion of a third hydroelectric generating station in the 12,000- square mile Campbell River system on Vancouver Island will bring installed total capacity of the public-owned British Columbia Power Commission to 280,000 hp. When fully developed, combined output of the three plants will be 400,000 hp.

The Campbell River watershed area, 180 miles north of British Columbia's capital, Victoria, comprises three storage dams and generating stations.

The Campbell River system powers the whole of Vancouver Island, except for the southern tip (metropolitan Victoria) served by a private utility. A feature of the system is a constant steady flow of water which is used three times. The multimillion-dollar project supplies urgently needed hydroelectric power while minimizing or preventing flood damage at the lower development level.

Consulting engineers on the project are H. G. Acres & Company, Ltd., of Vancouver.

High Road to London

A two-tier road beginning near the western outskirts of London is planned as a new and faster route to London airport.

This plan, first of its kind in England, has been adopted by the Min-

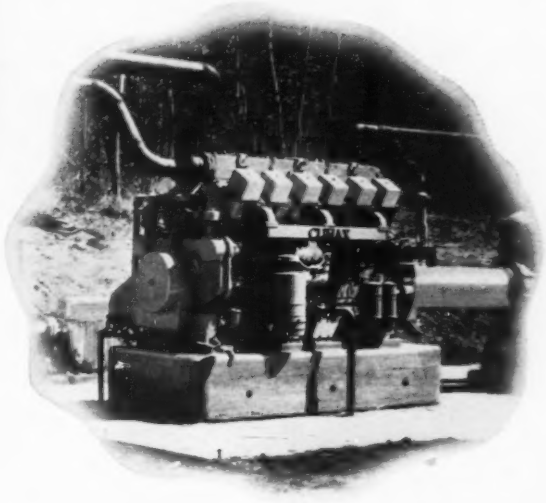
CLIMAX OFFERS MORE THAN ENGINE POWER

It's convincing enough to know that you bought the best engine for your service, but it's a lot more convincing to know that the parts and service man is just a quick telephone call away—*just in case you need him.*

This is one of three important reasons...our customers tell us...why they buy and are so satisfied with Climax Engines. Here is a recent comment:

"I bought my Climax Engine because I was able to select the one just right for my job. They showed me how easy it was to maintain, and this has proved completely true. What's more, I am more satisfied than ever now that the new Waukesha-Climax setup gives me the best service facilities I could ask for."

Get the complete facts from your Waukesha-Climax Distributor.



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Arizona: Phoenix
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6 cylinder to V-12. Maximum basic engine ratings: 40 to 605 hp. at 1200 rpm.

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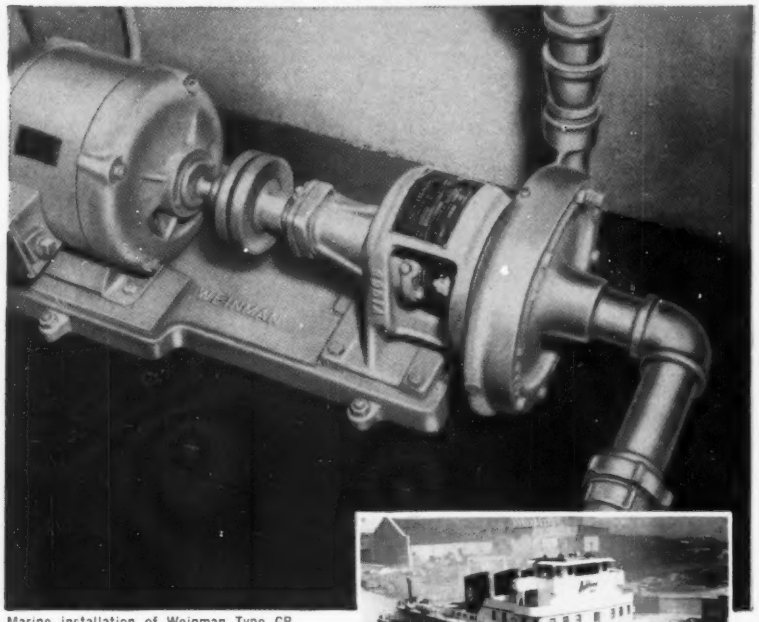
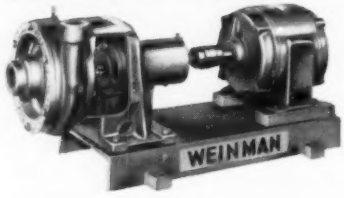
ONE WEINMAN TYPE GB PUMP INSTALLED...



Marine installation of Weinman Type GB pump on Allied-Ashland Oil Co. workboat.

all marine pumping worries over!



WEINMAN Type GB Frame Mounted, End Suction Pumps are *outstanding* for general service pumping. Practically unlimited in their fields of usefulness, they're favorites among engineers for many phases of liquid handling. Extremely compact, WEINMAN Type GB Pumps are specially useful where installation space is limited. Also, the discharge opening may be placed in any one of eight positions.

Available as a direct drive, motor operated unit, or with pulley for belt drive. Either type of drive performs efficiently, dependably, economically. Single stage; single suction; h.p. range, ½ to 50; heads to 260 feet; capacities to 2500 gpm.

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Write today for your free copy of WEINMAN'S *illustrated Bulletin 500, showing specifications, dimensions, construction features and complete selection table for* WEINMAN *Type GB Frame Mounted, End Suction Pumps.*

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CENTRIFUGAL SPECIALISTS

ister of Transport and Civil Aviation to avoid demolition of property that would have been involved in another proposed plan.

Sir Alexander Gibb & Partners have been appointed consulting engineers to investigate the traffic problem and make the layout.

About 12½ miles of new construction is involved. The viaduct will be 1½-miles long and 60-ft wide, with an average height of about 25 feet, but where it passes over a factory it rises to 65 feet.

Italo-German Autobahn

A planned 250-mile Venice-Munich express highway will tie in with a new port in Venice capable of handling oil transported from the oil-rich Middle East, and a proposed pipeline for onward transport of oil to central Europe.

The Venice-Munich highway is one of a network planned for fast travel from southern and northern Italy to France, Germany, Austria, and Switzerland.

Included in the network are the *Strada del Solc* running north from Naples; an extension of the Venice-Padova express highway to Brescia, where it will join the Brescia-Milan-Turin-Varese roads; and the Venice-Trieste highway.

The Venice-Munich highway will have an elevated two-level section running through the Alps. In winter when heavy snows, landslides, and avalanches occur, travel will be on the lower level.

Expansion of present port facilities at Venice is not practicable, especially for oil storage and refineries. Plans for the new port call for vessels to enter through Malamocco south of Port Venice, and deepening a canal running from Malamocco to the new port to handle 100,000-ton tankers.

The pipeline will start from the port and parallel the Venice-Munich highway, enabling tankers with fuel for central Europe to cut across the Mediterranean from the Middle East to the Adriatic, instead of sailing around Europe.▲▲

How do YOU lay out the heating and ventilating for today's new schools?

Who, ME?

Every schoolhouse architect and consulting engineer has probably heard about the sizable reductions in school building costs that have been effected by the introduction of the Nesbitt Series Wind-o-line System of heating, ventilating and natural cooling.

Not all are completely familiar with the layout and application of this unique system—which offers the highest standard of classroom thermal comfort of all such systems *plus* savings of 20% or more of the construction, equipment and installation costs entailed by the conventional system with pipe trenches and runouts.

Nesbitt is most anxious for you and any of your staff to be acquainted with the new and different, but not difficult procedures employed in the layout of the Nesbitt Series Wind-o-line System. We not only offer catalogs and engineering data, but we invite correspondence, and will even arrange conferences in your office, if desired. Thus, your clients can come to know the satisfaction and economy—and you, the good will and prestige—that result from the installation of Nesbitt Series Wind-o-line.

Write us your questions, ask for Publications 104 and 114, or tell us when a Nesbitt representative may see you.

Nesbitt

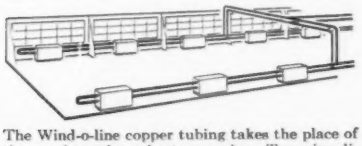
SERIES WIND-O-LINE SYSTEM

MADE AND SOLD BY JOHN J. NESBITT, INC., PHILADELPHIA 36, PA.

Sold also by American Blower Corporation and American-Standard Products (Canada) Ltd.

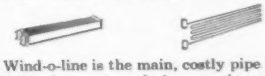
WHAT IS THE NESBITT SERIES WIND-O-LINE SYSTEM AND HOW DOES IT SAVE MONEY?

The system includes a Nesbitt Syncretizer unit ventilator in every classroom, with Wind-o-line finned radiation installed along the sill.

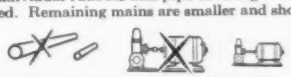


The Wind-o-line copper tubing takes the place of the usual supply and return mains. Two-pipe direct or reversed return circuits are used, with a group of classrooms or even an entire wing of the building in a single circuit. Each classroom is individually controlled.

The Syncretizer multipass heating element extracts the required heat from a smaller quantity of water. System water temperature is automatically varied with outside temperature.

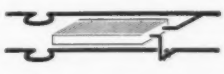


Since Wind-o-line is the main, costly pipe trenches, individual runouts and pipe covering are eliminated. Remaining mains are smaller and shorter.



Since only one-half to one-third the usual amount of hot water is circulated, smaller, less costly pipes and pumps are used.

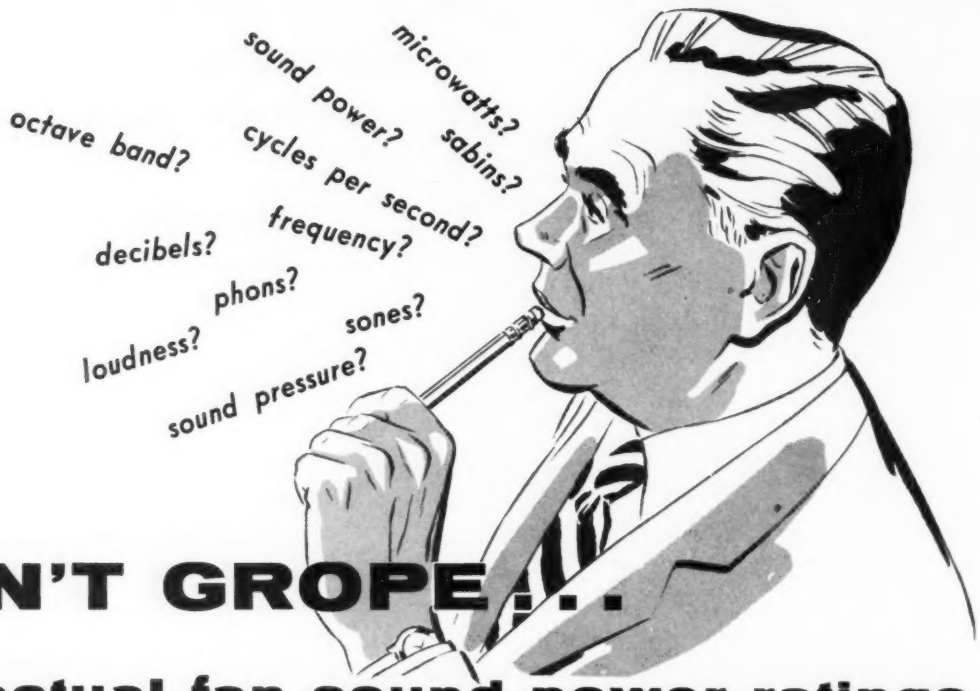
Packaged piping within the Syncretizer—crossover tubing, expansion loops, balancing valves, etc.—saves expensive jobsite fitting.



Wind-o-line protects against window downdraft and cold surfaces for as long as necessary, thus completing the protected learning environment.

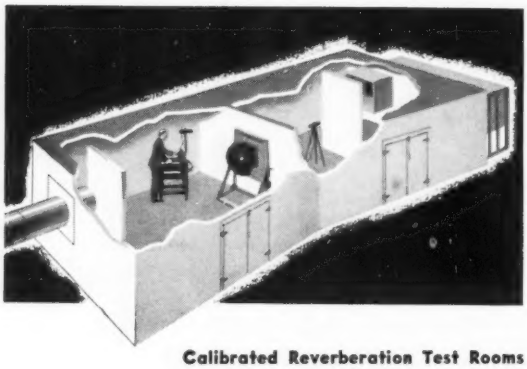
Wind-o-line gravity heat gives overnight temperature protection without other special controls.

Total savings enable even low-budget schools to have the last word in heating and ventilating.



DON'T GROPE . . .

for factual fan sound power ratings



Calibrated Reverberation Test Rooms
Cutaway view of DeBothezat's noise evaluation reverberation test rooms, designed and calibrated by the acoustics staff of Armour Research Foundation.

COMPARISONS AND PAPERWORK can't provide the kind of data you need on the sound power output of fans. That's why DeBothezat built and equipped these modern testing facilities. These special facilities and equipment are used to log the sound power output of every DeBothezat fan, on *both* inlet and outlet sides.

Ratings on all DeBothezat fan units, measured as a complete assembly, are stated in both microwatts sound power and decibel sound pressure level in each of 8 octave bands of frequencies, measured separately. Next time you specify or install fans, ask your DeBothezat Sales Engineer for full information on the specific units considered.

"Controlling Ventilation Noises"

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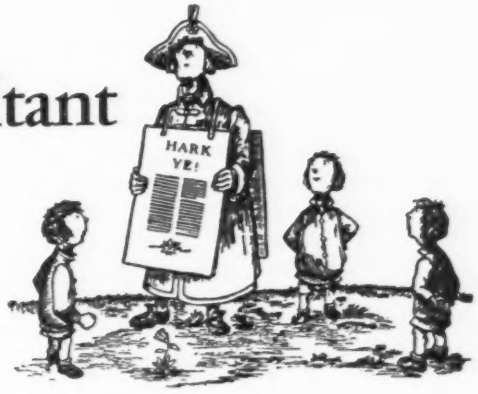
News for the Consultant



Giant Particle Accelerator for Argonne

The firm of Sverdrup and Parcel, Inc., of St. Louis, has been named by the Argonne National Laboratory for design work in connection with the 12.5-billion electron volt zero-gradient proton synchrotron to be built at Argonne's main site near Lemont, Ill.

The contract was awarded by the Laboratory on the recommendation of a selection board.

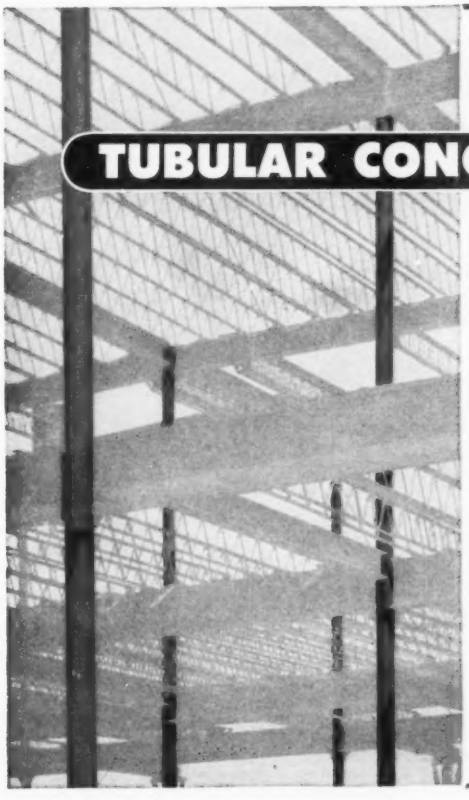
Cost of the particle accelerator and supporting facilities at Argonne currently is estimated at $27 million. The Atomic Energy Commission has made available $1.5 million initially for design work.

The new accelerator will produce greater numbers of accelerated particles than any other of the multibillion electron volt accelerators now in operation or under construction anywhere in the world. It will be the largest basic research tool of its type ever built in the midwest.

Facilities for the accelerator will cover about 60 acres of Argonne's 3700-acre site. Its permanent staff will include 135 scientists and technicians.

The unit will be housed in an earth-covered tunnel 200 feet in diameter. The supporting facilities will include about 10 laboratory and auxiliary structures.

The architect-engineer contract covers the design of buildings and normal building services. Included are foundations, structures, grading, plumb-



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ing, heating, ventilating, lighting, telephone and intercommunication services, water, wiring, roads, parking areas, sidewalks, and a railroad siding. Certain other work will be done jointly by Argonne and Sverdrup and Parcel, Inc., including connections with plant utility services.

The particle accelerator will have a doughnut-shaped magnet installed within the earth-covered tunnel. Weighing approximately 4000 tons, the accelerator's magnet will be ten-ft wide and six-ft high. It will be constructed of laminated steel plates stacked against one another vertically and insulated from each other.

Wolff Attends FIDIC Meeting

Edward J. Wolff, president of the Consulting Engineers Council, was its representative to the annual meeting of the Federation International des Ingeniers-Conseils (FIDIC), held at Oslo, Norway last month. Mr. Wolff attended as an accredited observer at the invitation of Julian S. Tritton, president of FIDIC, and the Norwegian Association of Consulting Engineers, host to the international group.

Mr. Wolff served as an ambassador for American engineers in private practice. In outlining his objectives, Mr. Wolff said, "I went to Europe not only to observe finer professional practices, but to bring back practical suggestions that will permit American engineers to regain their initiative in the struggle for scientific advancement."

It is expected that on his return, Mr. Wolff will report his detailed findings, not only to the Consulting Engineers Council, but to various agencies of the United States government.

Mr. Wolff conducts his own engineering firm in Chicago and is affiliated with the firm of John F. Meissner Engineers, Inc.

Los Angeles Sports Arena Studied

A study has been completed for the Los Angeles Memorial Coliseum Commission for the establishment of an indoor sports arena and exposition hall in Los Angeles by Ebasco Services Incorporated, New York engineering, construction, and business consulting firm.

Owner and operator of the 101,000-seat Memorial Coliseum, current home of the Los Angeles Dodgers, the Memorial Coliseum Commission plans to build and operate, on a site adjacent to the Memorial Coliseum, an indoor sports arena and exposition hall designed to seat up to 19,300 spectators.

Ebasco worked for the Coliseum Commission on the project on several occasions from November, 1955 through March, 1958. The purpose was to review business and economic aspects of the plan,

Why drinking water at the Jack Tar is Temprite cooled

Remote drinking water coolers by Temprite are ideal for outside areas, such as the swimming pool area adjoining the Jack Tar Hotel in Galveston, Texas. The Remote Cooler can be installed behind building walls or any concealed area, and connected to one or more bubblers located on the outside walls. There's no costly piping and the condensing unit is fully protected from the elements.

CAPACITIES of Temprite Remote Water Coolers range from 6 to 24 g.p.h. and from 1/5th to 1/2 h.p.

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PRODUCTS CORPORATION

THE QUALITY LINE

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Birmingham, Mich.

appraise the outlook for the sports arena, and establish a basis for negotiating the financing necessary for its construction.

Estimated to cost approximately $5,822,000, the undertaking will be financed principally through the public sale of $7.8 million in revenue bonds by the Los Angeles Memorial Coliseum Commission through investment bankers headed by Blyth & Co., Inc. and Wagenseller & Durst, Inc.

One of the principal features of the studies conducted by Ebasco was an estimate of the revenues, expenses, and earnings of the proposed sports arena. Among other phases studied were investigation of the need for the proposed sports arena and exposition hall; review of the program of sports events, entertainments, and trade exhibits; appraisal of the competition that might be offered in the Los Angeles area; review of plans to provide parking facilities; policies and operating plans; and review of the operating and earnings record of the Memorial Coliseum.

Reactor Hazards Study Completed

A hazards evaluation study of what is expected to be the first commercially owned, high neutron flux test reactor licensed by the U. S. Atomic Energy Commission has been undertaken by the Los Angeles consulting firm of Holmes & Narver, Inc. The assignment is from the Atomic Power Department of Westinghouse Electric Corporation. The reactor will be located near Pittsburgh.

Coast and Geodetic Survey in Pennsylvania

A 20-man crew of the U.S. Coast and Geodetic Survey has begun to aid in developing more accurate measurement of distances in highway design work in Pennsylvania. The crew will establish control points, to be marked by bronze discs set in concrete monuments two to five miles apart, along the 1500-mile interstate highway route. The state highway department will utilize photogrammetry and its new Tellurometer, a portable device for rapid measurement of distances through use of sound waves. Surveys similar to Pennsylvania's are being made in other states.

Consultants Selected for New Capital Airport

The Civil Aeronatics Administration has announced the award of a contract to Ammann & Whitney, Consulting Engineers, for the architectural and engineering services for the planning, design, and supervision of construction of the new Washington International Airport, at Chantilly, Va. The engineering firm of Burns and McDonnell, Kansas City, and the architectural firms of Eero Saarinen and Associates, Bloomfield Hills, Mich., and Ellery

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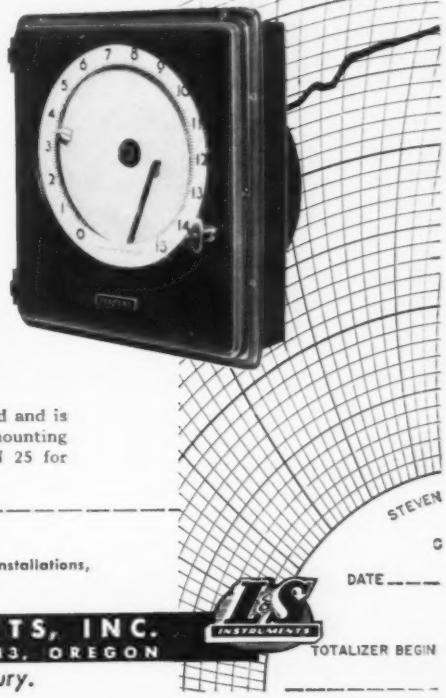

Recording, indicating and totalizing meter for measuring sewage or other flows over Parshall flumes and weirs. This instrument has interchangeable flow cams and flow conversion gears... an important factor to consider for sewage treatment plants in rapidly growing communities. With a simple change of cams and gears the Type B-FT Recorder can operate with a different size flume or accommodate a greater range of flow than that for which it was originally purchased. The change does not require factory service. Similarly, change from weekly to daily time scale, or vice versa, is accomplished by merely repositioning one gear — no new parts to buy.

This recorder can be direct float operated or remotely controlled and is available for wall or switchboard mounting, or with cabinet for mounting out of doors directly over the float well. Request BULLETIN 25 for complete details.

STEVENS DATA BOOK

Invaluable for your reference file. Contains technical data on recorder installations, plus a wealth of hydraulic and conversion tables. $1 copy. (No COD's)

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Specialists in hydrologic instruments for over half a century.

Husted, Washington, D.C. will be associated with Ammann & Whitney on this venture.

The project consists of the complete airport, including a terminal building, control tower, service building, and all related mechanical and electrical facilities and services. An access highway also will be built as part of the project.

In addition to its work in the development of airports and airport facilities, both in the United States and abroad, the firm of Ammann & Whitney is internationally known for the design of major bridges, expressways, and intricate buildings. Their experience includes the design of the George Washington and Bronx-Whitestone Bridges, in New York City, and the Walt Whitman Bridge, in Philadelphia.

World-Wide Corrosion Studies Completed

Ebasco Services Incorporated, of New York, have announced the completion of corrosion engineering studies on major projects throughout the world.

For the United States Naval Station in Bermuda, plans and specifications have been drawn up for cathodic protection of underwater steel for two seaplane ramps. Zinc galvanic anodes will be used on these ramps.

Presently being installed on a 2000-ft long pier at the Free Port of Monrovia, the capital city of Liberia, which lies on the southwest coast of Africa, and on a bridge across the Mesurado River near Monrovia, are corrosion preventive measures recommended by Ebasco. Underwater protection of approximately 1100 steel piles involved on these projects will be accomplished economically with a current of 2000 amperes supplied by galvanic anodes of zinc. One half-million pounds of zinc will be required for this installation. The zinc anodes will be fabricated of high purity zinc alloyed with 0.1 percent aluminum.

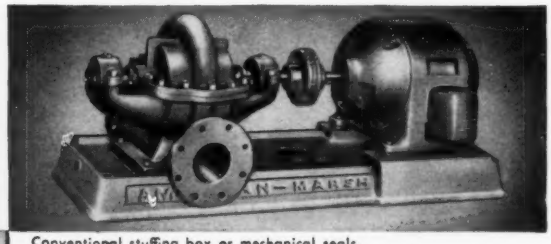
The above-water portions of the steel piles are being encased with reinforced concrete to prevent further corrosion and to impart additional mechanical strength to piles that have been weakened seriously by corrosion.

Installation of the corrosion preventive measures on the Monrovia projects currently is being made by the N. J. Nederhorst Construction Co., Ltd., of Couda, The Netherlands.

Now in preparation by Ebasco engineers are plans and specifications for the installation of corrosion preventive procedures following a comprehensive study of the U.S. Army's corrosion problem on the island of Okinawa.

For Texas Eastern Transmission Corp., one of the nation's leading natural gas pipeline systems, Ebasco currently is supervising the installation of cathodic protection facilities on a 420-mile section of

Install American-Marsh
PUMPS LIKE THIS



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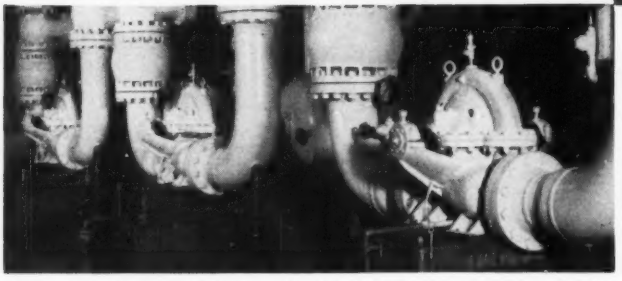

Above — Three bronze-fitted American-Marsh Centrifugals, with direct drive 150 HP motors, each circulate up to 2,000 GPM of chilled water in air conditioning system.

WHEN YOU SELECT or recommend an American-Marsh Pump, you know it's backed by 80 years' experience in building pumps — and pumps only! WHEN YOU INSTALL it, you know it was individually factory tested to meet all specifications before shipment. (*Every* A-M pump is fully tested!) IF YOU'D LIKE suggestions on the best type and size for *your* job, call your American-Marsh representative. He'll help make sure *your* pump gives permanent satisfaction!

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WRITE FOR BULLETIN 350 for details of Model HLM above — or describe your application.

CENTRIFUGAL, TURBINE, STEAM AND POWER PUMPS FOR TESTING, PROCESSING, BOILER FEED, FIRE PROTECTION, ETC

30-in. pipeline, together with over 275 miles of connecting lines and laterals ranging from 3- to 24-in. diameter. The main line is known as the 30-inch McAllen-Vidor Pipeline and extends from McAllen, on the Rio Grande River in South Texas, to Texas Eastern's compressor station at Vidor, located near Beaumont, Texas.

Installation work involves rectifiers or galvanic anode beds at 54 different locations on the system. Rectifiers are used to supply the bulk of the current required on the main line and on the larger laterals. Both zinc and magnesium galvanic anodes are being used for supplying small increments of current required on smaller lateral lines and at certain locations such as salt water crossings and stream crossings along the main line route.

Drafting Aid

Accurate plans and diagrams now can be produced quickly even by inexperienced personnel, through the use of a simple instrument, according to a British inventor. The new device, Quickdraw, is a portable transparent template cut with mathematical accuracy to the principal geometric shapes. The template is fixed to a toggle hinge to form a pantograph, and is attached to a folder base. Quickdraw is in widespread use at Britain's Atomic Research Center, at Harwell, and about 20,000 professional and amateur designers are said to be using the device in a variety of industries. The manufacturer is Quickdraw Co., Ltd., 127 Ginnersbury Avenue, London, England.

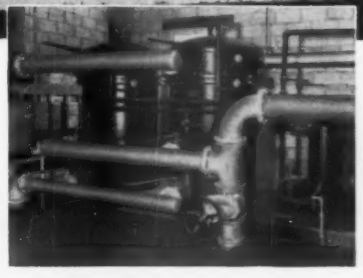
Guam to Get Big Housing Project

The U.S. Air Force Strategic Air Command currently is calling for bids for a new $20-million housing project to be constructed at Andersen Air Force Base, Guam. The project will include 1050 units of both single and duplex buildings for housing enlisted and officer personnel. The program also includes construction of streets and utilities.

The entire project, one of the largest housing developments ever scheduled by the Air Force, has been planned, designed, and engineered by Daniel, Mann, Johnson & Mendenhall, Los Angeles architectural-engineering firm.

DMJM has designed the units to be of tilt-up reinforced concrete walls and precast reinforced concrete roofs. Optional construction of concrete block walls or precast concrete panels will be allowed. The buildings must be able to withstand the typhoon winds which occasionally strike the island.

Prevailing trade winds, constantly blowing over the island, will be used to provide air circulation for comfortable living. Aluminum louvers were specially designed to secure the maximum benefits



Shown above is the beautiful Oxon Hill Country Club Pool, Oxon Hill, Maryland which uses an Adams 1-SPF-169 filter to handle the almost 200,000 gallons capacity. Ted Messenger and Associates, Washington, D.C., were the consultants.

Adams SPF swimming pool filters are available in sizes from 53 to more than 1000 square feet of filter area. Normally all sizes can be shipped from stock. A typical unit is shown at the right.

Sorry . . . but we do not offer filters for your client's backyard pool.

when you specify

ADAMS SWIMMING POOL FILTERS

you enhance your professional standing

Your professional reputation is your most important asset. Will a happy client today be happy five years from now? When you specify the proven, trouble-free and yet competitively priced Adams filter for your commercial, municipal or institutional client, you can be sure of the integrity of your reputation in the years to come.

That's because ours is a quality product. All inner surfaces are sand blasted and have three coats of vinyl lining . . . tube support rods and nuts are stainless steel . . . closure plates and clips are galvanized forged steel . . . our *Poro-Stone* media is inert to chemical corrosion and electrolytic action of chlorinated water.

Complete details are furnished in our new technical Bulletin 626. This bulletin was prepared with you specifically in mind. Why not write today . . . on your letterhead, please . . . and we will send it to you promptly? Your client deserves the best you can specify.

R. P. ADAMS CO., Inc. 256 East Park Drive, Buffalo 17, N.Y.

of the cooling breezes. Lanais and large window areas will permit a maximum indoor-outdoor living arrangement compatible with the island's climate.

Bechtel Named for Nebraska Reactor

The Atomic Energy Commission has selected the Bechtel Corp., of San Francisco, Calif., as the architect-engineer for the nuclear reactor to be constructed at Hallam, Nebr., under a cooperative arrangement with the Consumers Public Power District of Nebraska.

The nuclear power plant will be operated by Consumers as part of its electrical generating system. The Commission has assigned technical responsibility for the nuclear reactor facilities to Atomics International, a division of North American Aviation, Inc., of Los Angeles.

The project will consist of a sodium graphite reactor supplying steam to conventional turbogenerator equipment. The plant is to be designed to produce 75,000 net electrical kw of electricity. Approximately three and one-half years will be required for design and construction.

New Sewage Plant for Connecticut

An important step in Connecticut's program to rid its rivers and streams of pollution was taken early this year when the city of Willimantic began construction of a half-million dollar sewage treatment plant with a capacity to treat 2.2-million gallons of raw sewage per day. The city also is adding two miles of intercepting sewers, at a cost of $115,000, to serve areas now dependent on septic tanks.

At present, this industrial city in central Connecticut discharges its raw sewage at a point where the Willimantic and Natchaug Rivers meet to form the Shetucket, a tributary of the Thames. The present dry weather discharge is approximately 1.8-million gallons per day. The greater capacity of the new sewage treatment plant will provide for growing suburban areas and an expected industrial expansion.

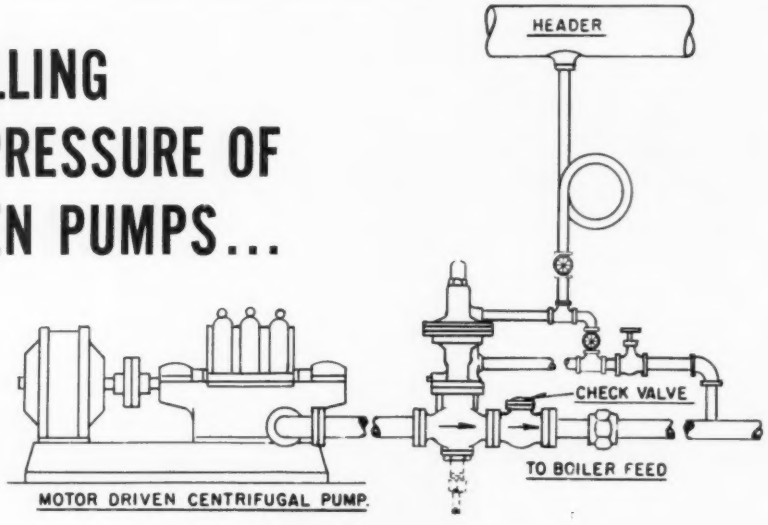
The sewage treatment plant now under construction is of the primary sedimentation type designed for a dry weather flow of more than two-million gallons a day and capable of treating up to six-million gallons per day during storms. Settled effluent will be discharged into the Shetucket River and sludge removed by sedimentation will be stabilized by digestion, dewatered on vacuum filters, and disposed of as fill.

The new sewage treatment plant and the intercepting sewers were designed by the Sanitary Engineering Department of Gibbs & Hill, Inc., New York consultants, who were originally retained in 1947 by the city to make an engineering study of

FOR CONTROLLING DISCHARGE PRESSURE OF MOTOR DRIVEN PUMPS...

... Foster Automatic Regulators and by-pass valves are being used as pump governors on excess pressure service, constant pressure service, or as relief valves to by-pass overpressure back into the suction.

Materials of construction are specially selected to handle boiler feed water, and each governor may be set in the field for predetermined operating pressures. Data sheets on request.



Typical Excess Pressure System

FOSTER ENGINEERING COMPANY
835 Lehigh Avenue • Union, New Jersey
AUTOMATIC VALVES • SAFETY VALVES • FLOW TUBES • CONTROL VALVES

the city's domestic water supply system. The recommendations embodied in that report were approved, and the work—involving a new distribution loop, improvements to the existing reservoir, a new standpipe, increased capacity of the existing pumping station, and enlargement of the water treatment plant – was carried out in 1951.

McAneny Outlines M. W. Kellogg Program

The director of The M. W. Kellogg Company's newly established Industrial Products Division, J. M. McAneny, has pointed out that his firm's policy of assuming full responsibility for the engineering, procurement, and construction phases of large-scale plant projects is a stimulus to capital investment which is needed to combat the recession.

Mr. McAneny stated that the creation of capital goods is important to America's leadership in international affairs, and that increased productivity only could come about by replacement of obsolete plants with those embodying the latest technological advances.

He then outlined the role Kellogg hopes to play in the broad national program to encourage new investments, saying that a decision in either engineering, procurement, or construction affects the costs and schedules in the other two areas with a resultant effect on the over-all investment cost.

Kellogg's experience, McAneny stated, in the petroleum and petro-chemical industries indicates that its unique organization and philosophy of operation has proven itself. The new division was formed to sell Kellogg's coordinated services outside the petroleum and petro-chemical industries.

Burns and Roe Presents Awards

Burns and Roe, Inc., consulting engineers of New York, with a professional staff of nearly 1000, has honored 137 of its employees for long-term service to the company.

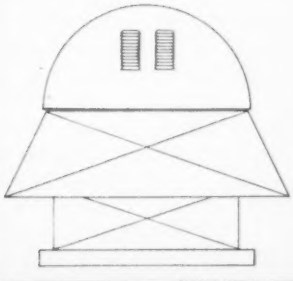
A 20-year award was presented to R. C. Roe, president and chairman of the board of directors. One of the firm's principal founders, Roe has been well known in the engineering field for over three decades for his many innovations in power plant design. He is a registered professional engineer in the states of New York, New Jersey, Michigan, Maryland, and Tennessee.

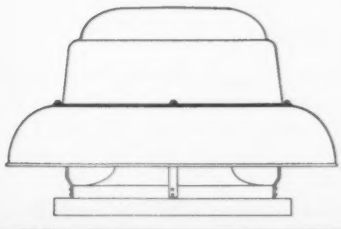
Also honored for 20 years' service were J. B. MacLean, chief electrical engineer; P. J. McCoy, chief civil engineer; and Miss J. Laurencelle, corporate secretary who has worked with Mr. Roe for 32 years.

Fifteen employees received 15-year awards, 53 people received 10-year awards, and 65 employees were honored for 5 years' service. ▲▲

new LC* dynafans by PENN

REDUCE ROOF EXHAUSTER HEIGHTS





ALMOST ONE HALF!

*low contour

Penn's new Low Contour Dynafans now offer unlimited possibilities for architectural building designs where streamlined silhouettes are desired.

Reduced in height to almost one-half the size of conventional exhausters, this versatile unit contains all of the important features found in Penn's standard model LVQ (Low Velocity Wheel Design) units plus many improvements for lengthening unit life due to new straddled bearing design.

Complete performance data and technical information can be had by writing for Dynafan Bulletin PD-42LC or contacting the Penn Ventilator man in your area.

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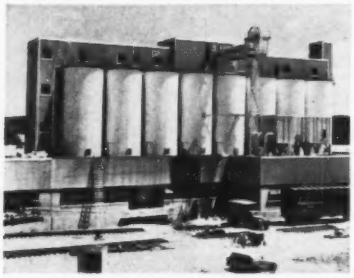
SAVE
with a MARIETTA STORAGE SYSTEM Engineered to your own needs



MARIETTA STORAGE SILOS can be tied in with plant construction for efficient processing of materials.

• You'll realize a big savings in time, money and materials when you install a modern Marietta Storage System.

Sturdy, interlocking concrete stave silos save materials by keeping them dry, free from waste, protected against weather or fire. And there's practically no maintenance to Marietta storage silos.

Conveyors, feeders, discharge systems or other specially designed equipment save material handling time and speed-up your operation. Whatever bulk material you use, you can depend on Marietta's know-how to design and erect the most efficient system for your need. The complete job will be handled under one cost-saving contract or in cooperation with your engineering staff, consultants or contractor.

Write today for an analysis of your storage problem and ask for a copy of the Marietta Industrial Storage Systems Booklet.

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BRANCH OFFICES:
501 5th Ave., New York 17, N. Y., Jamestown, N. Y., Baltimore 21, Md., Charlotte 6, N. C., Nashville, Tenn.

Men in Engineering

Isadore Director and Ira L. Meyer have announced the formation of a partnership, Director & Meyer, Engineers and Consultants. The offices of the firm will be located at 16 S. Broad St., Philadelphia.

George H. Miehls, president of Albert Kahn Associated Architects and Engineers, Inc., Detroit, since the passing of the founding Kahn brothers in 1945, has relinquished this post to devote his full time to the positions of chairman of the board and treasurer of the firm.

MIEHLS KING

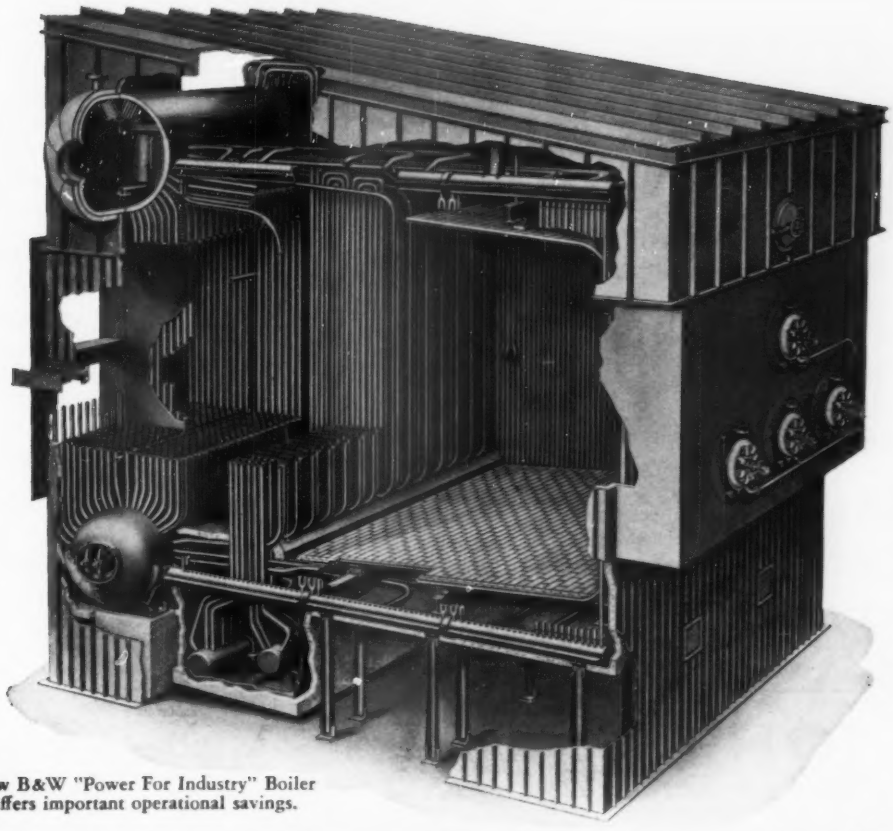
Sol King, a veteran of more than 23 years with the Kahn organization, has been elevated to the presidency, effective immediately, from his former post as a vice president. Officers re-elected include: Sheldon Marston, executive vice president; George K. Scrymgeour, vice president and secretary; Robert E. Linton, vice president in charge of civil and structural engineering; Saul Saulson, vice president in charge of mechanical engineering; Geoffrey S. Whittaker, vice president and assistant chief mechanical engineer; and Virgil C. Wagner, vice president in charge of electrical engineering.

Albert A. Hellman and Allen Lober announce the opening of offices for the practice of mechanical engineering to be known as Hellman & Lober, Consulting Engineers. Offices will be at 900 South Robertson Boulevard, Los Angeles. Hellman formerly was chief mechanical engineer and associate in the firm of Arthur Froehlich & Associates, Architects and Engineers; Lober previously was associated with the firm of Freed and Lober.

James L. Frazier, Consulting Engineer, formerly with Frank Mayer Engineering Co., has opened offices at 1020 Wilshire Blvd., Santa Monica, Calif.

Henry L. Hoeppner has resigned his position as consulting electrical engineer with Pioneer Service & Engineering Co., Chicago. Thomas O. Millard has been appointed to the position of chief electrical engineer of the same firm.

Announcement is made of the formation of the consulting engineering firm of Collings-Vranich and Associates with offices at 625 North



New B&W "Power For Industry" Boiler offers important operational savings.

New Economical Power For Industry

B&W "PFI" Oil-Gas Burning Boiler Provides Maximum Output in Minimum Space

Here's an answer to industry's need for an economical, dependable steam supply. The new B&W Integral-Furnace Boiler produces high-quality, dependable steam economically at all ratings. Aptly named the PFI, the "Power For Industry" Boiler is compact, easy to install, quick to meet rapid and wide load swings. The new boiler gives long, sustained operation, requires little attention and is readily accessible for inspection, cleaning and maintenance.

Here are eight ways in which the PFI Boiler can be of benefit to you:

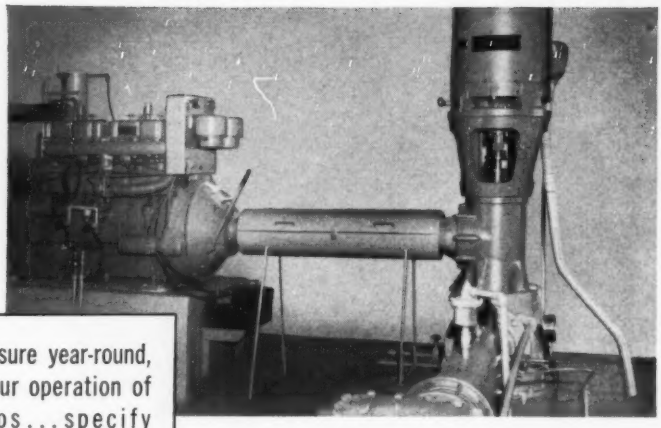
1. It requires a minimum amount of space for a given power output.
2. The pressurized furnace design assures economy by eliminating the induced draft fan and air infiltration. This means savings in cost of fans, fuel, and operating power.
3. Pre-assembly of many of the components of the PFI Boiler is controlled in B&W shops, resulting in a reduction of the time and manpower required for field erection.
4. The PFI is designed to burn oil, gas, or a combination of the two. When it is equipped with a dual-fuel burner, it allows you to take advantage of favorable market conditions.
5. Cyclone Steam Separators insure adequate water circulation which protects boiler tubes from overheating, even with wide and frequent changes in load. They also give you clean, dry steam at all designed ratings with high boiler water concentrations.
6. The drainable superheater design assures quick, safe start-up and ease of storage.
7. Water-Cooled Burner Throat eliminates troublesome maintenance, costly repairs.
8. All-Welded Membrane Wall contributes to high efficiency and reduces insulation requirements.

B&W has placed over 4,000 Integral-Furnace Boilers of various types in service over the past 25 years alone. This experience is your assurance of quality. For further information, write for Bulletin G-94. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

G-892A-IF

BABCOCK & WILCOX

BOILER DIVISION



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Protects water supply, sewage and flood control operations against power failures; also permits overhauling electric motor or power unit without interrupting service. Thousands in use by municipalities, industry and farmers. Available in turbine or engine driven combination drive (as shown here), standard and dual types, with either hollow or solid shaft. Sizes: 15 to 450 hp. Write now for engineering catalogs.

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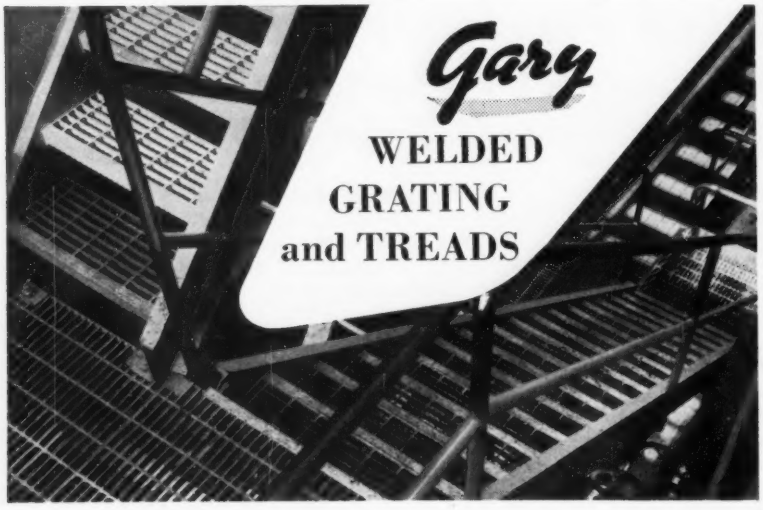

Gary

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- **TAILOR MADE**—for most economical installation.
- **RIGID STRENGTH**—sturdy resistance-welded construction.
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- **SELF-CLEANING**—for reduced maintenance costs.
- **OPEN CONSTRUCTION**—gives maximum ventilation and illumination.

ROCKWELL-STANDARD CORPORATION

(Formerly Rockwell Spring and Axle Company)

GRATING DIVISION

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Milwaukee St., Milwaukee. The principals of the firm are William T. Collings and Emil F. Vranich. The new firm will render engineering design services to architects and industry throughout Wisconsin and neighboring states.

Col. Bennett H. Griffin, recently retired as a director, Washington National Airport, Washington, D.C., has become associated with Howard, Needles, Tammen and Bergendoff, Consulting Engineers, as special aviation consultant. He will make his headquarters in the firm's office at the Miami International Airport, Miami, Fla.

The firm currently is retained as consulting engineer for the improvement program now in progress on the Miami airport. Col. Griffin will participate actively in this program.

GRIFFIN BRILEY

Harold D. Briley, vice president of Briley, Wild & Associates, Daytona Beach consulting engineers, has taken office as president of the Florida Engineering Society. Briley, Wild and Associates were organized in January 1950 to provide private and governmental consulting service in water distribution, sewage collection, water and sewage treatment, and other municipal projects.

James O. Starkweather, a registered professional engineer, has joined the Industrial Engineering Department of Ebasco Services Inc. as a paper mill engineer.

Parsons, Brinckerhoff, Hall & Macdonald, Engineers, have moved to

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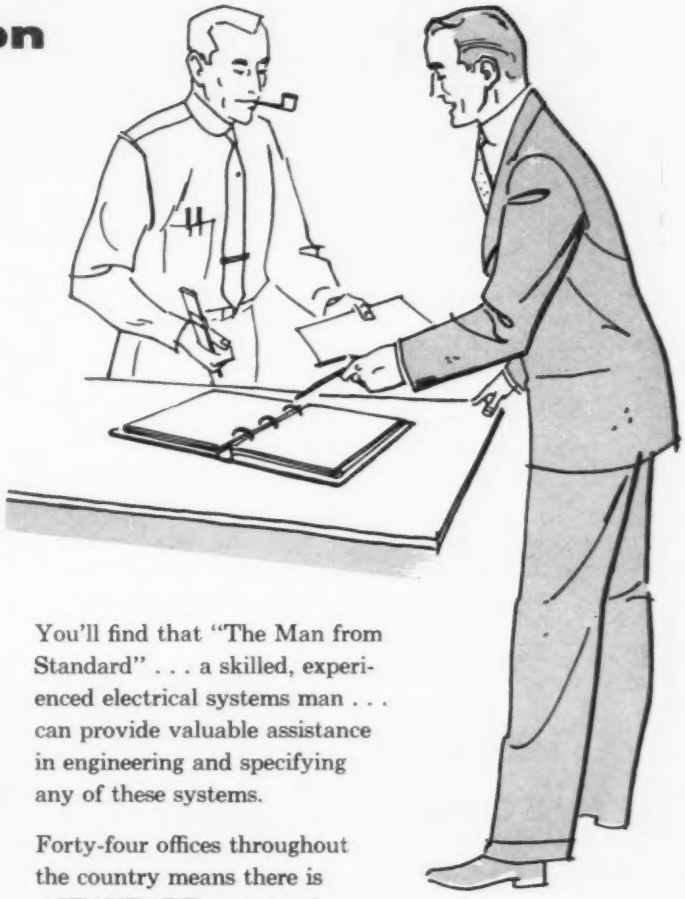

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With exclusive "Memory Tape" control. The *proved* and *preferred* systems for schools, institutions . . . wherever signals must sound on schedule.

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Automatic Nurse Saver® two-way communication systems, doctors paging systems, staff registers, central radio and music systems.

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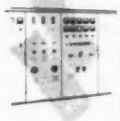
100% electrically supervised systems featuring instantaneous, automatic operation and automatic recovery.

★ VOLTAGE DISTRIBUTION SYSTEMS



Famous Flexlab® laboratory equipment, including switchboards, power supplies, service units, motors and generators, dynamometers.

You'll find that "The Man from Standard" . . . a skilled, experienced electrical systems man . . . can provide valuable assistance in engineering and specifying any of these systems.

Forty-four offices throughout the country means there is a STANDARD man nearby. And his job is to serve *you*, the consulting engineer.

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Does your library include this file of data sheets containing complete specifications on Standard systems? If not, we will be glad to supply one on request.

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SPECIAL DELIVERY for liquids and gases in all branches of industry is assured with Kraloy Rigid Polyvinyl Chloride (normal and high impact) Plastic Pipe... with virtually no maintenance or policing. You install Kraloy PVC—and forget it. That's why millions of feet of Kraloy Plastic Pipe are in use today, because Kraloy PVC is inert and can never rust, rot, or corrode, is not subject to electrolytic action, handles abrasives, slurry and most Ph factors, is scale resistant. Superior flow characteristics (C factor = 150+) permit use of smaller diameters. Installation costs 50% less, due to light weight and ease of handling.

Write for complete information and literature.

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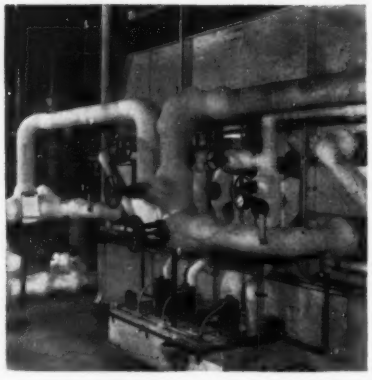
...a machine with "A GOOD RECORD as a REVENUE PRODUCER"



A typical case of using a Niagara Aero Heat Exchanger to provide cooling for production equipment shows amortization of this machine in 16 months and $90 per day revenue thereafter.

Industrial engineers with careful cost, upkeep and revenue records on all machines, credit Niagara Aero Heat Exchangers with important gains over other methods.

They use these machines to provide cooling for production equipment, welders, extruders, drawing dies, furnaces, quench baths, plating, chemical and electronic process...all millwater system uses.

They get positive control of critical process temperatures with improved product quality, rejection losses prevented. Heat is removed at the rate of in-put.

A closed system, dirt free prevents all troubles from bad water; transferring heat to the atmosphere by the evaporation of a very small amount of water solves all problems of water supply or disposal.

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NIAGARA BLOWER COMPANY

Dept. CO-6, 405 Lexington Ave., New York 17, N.Y.

Niagara District Engineers in Principal Cities of U. S. and Canada

larger offices on the 23rd and 24th floors of 165 Broadway, New York.

This firm, established in New York City in 1885, always has maintained headquarters in downtown Manhattan. For the past 10 years, the firm has occupied offices in three adjoining small buildings on lower Broadway.

The comptroller and two construction managers located in the Boston office of Stone & Webster Engineering Corp., have been elected vice presidents, it was announced by T. Cortlandt Williams, president of the firm.

The three new officials of the Boston and New York engineering and construction company are Arthur J. Good, comptroller, and W. L. Sheets and H. N. McCampbell, construction managers.

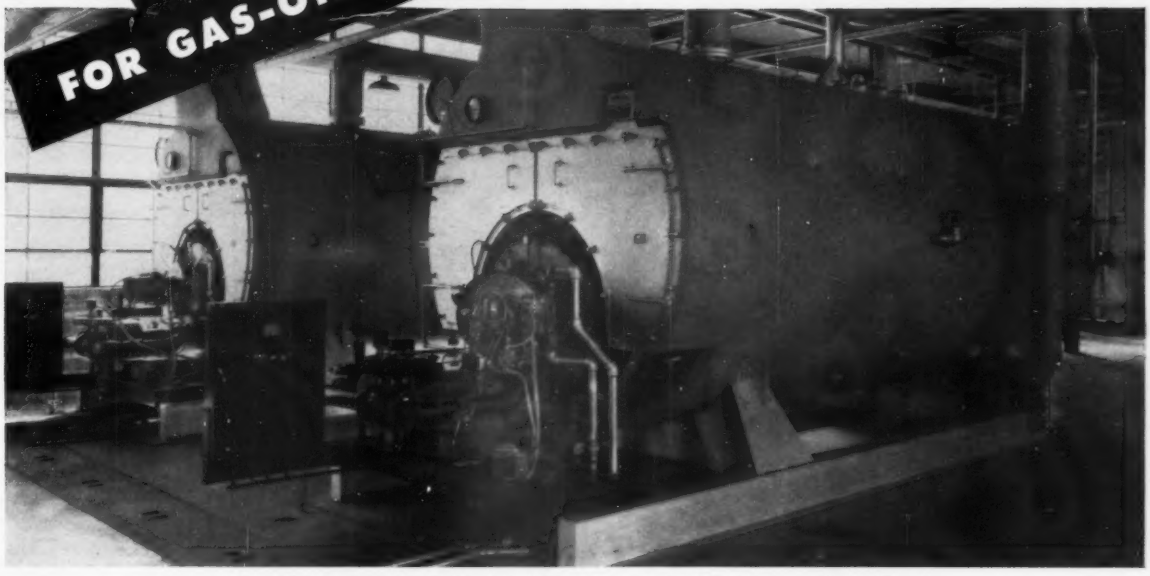
SHEETS GOOD

Stone & Webster also has announced the appointment of Elliot F. Jaquith as chief engineer for the newly instituted Industrial Projects Division.

Aries Associates announce the appointment of Gilbert E. Collyer to the position of contract manager. Collyer will be responsible for consulting liaison between the chemical process and electronics industries and the Aries organization in the United States.

Seelye Stevenson Value & Knecht, Consulting Engineers, of New York City, announces the admission to partnership of William D. Bailey. Bailey formerly served as an associate of the firm, and will continue to act as manager of the

FOR GAS
FOR OIL
FOR GAS-OIL COMBINATION



Petro Boiler-Burner unit installation at the Lambert-St. Louis Municipal Airport , St. Louis, Missouri

Here in one complete package . . . is the PETRO FORCED DRAFT FIRING SYSTEM

Available as a complete boiler-burner unit. The Petro firing unit, integrated with matched Scotch boiler (as shown above), is a complete boiler-burner unit. Installation consists of little more than attaching fuel and power lines. No pitted boiler settings; no high stacks; no separate air supply; no panel wiring. It is a thoroughly engineered unit, factory tested, with all vital components matched and mounted on a single base.

Available as a burner unit only . . . will fit any boiler. Petro firing units can be applied to any boiler. The entire system is factory-built, wired and tested. Everything needed for ultra modern firing is mounted on a rigid steel frame ready to bolt to the boiler front. Integrated air system makes the usual firing arch, firebox pit and brick checker floor unnecessary.

Saves installation costs. Whether you buy the complete boiler-burner unit or install the Petro forced draft firing system in your present boiler, you save time and money and avoid several local contracts. The job is backed by factory responsibility. All the needed component parts have been engineered and installed as a working unit fitted to specific boiler and fuel requirements . . . it's ready to render peak service from the very start.

No stack needed. Petro forced draft firing units eliminate high stacks. In fact, the only flue connection necessary is to a simple vent for the spent products of combustion. Unlike induced draft systems, the Petro blower operates in clean, relatively cool air. No maintenance problems arise from overheated bearings or corrosive gases. Power consumption is cut, too, for with the contracted volume of cool air, a motor only about one-half as large as that used with induced draft burners is required.

Switches fuels quickly. The combination gas-and-oil firing system embodies distinct advantages of continuous operation. Alternate fuels may be introduced in as little as 60 seconds. No extended shutdown of equipment. Controls for completely automatic changeover of fuels are also available.

For more information please mail the coupon.

See Petro Catalog in Sweet's Architectural File

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PETRO, 3221 West 106th Street, Cleveland 11, Ohio.
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Please send catalog and specifications on Petro gas and oil firing units.

Name_____

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100% financing for your new plant

Complete financing for Lease-Purchase of a new plant is available in labor-surplus areas of Pennsylvania through combined efforts of lending institutions, non-profit community organizations and the Pennsylvania Industrial Development Authority. Interest as low as 2%, with deferred amortization, can be applied on up to one-half of total plant cost.

100% financing is also available in other areas of the State, provided by community organizations, banks, insurance companies and other sources. You select the community you want. You specify plant construction details or choose one of several plant "shells" now being readied for completion.

100% Financing at a glance . . . Industrial Plant Construction Costs—

Subscribed by local non-profit community sponsored builder-owner corporations.	*20%*
2nd Mortgage Loan, Pennsylvania Industrial Development Authority.	*30%*
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Total financing, secured through local subscriptions and mortgage loans, without cash investment by the manufacturer.	*100%*

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PLANT:
Green's Bayou, Houston 15, Texas

TODD
NEW YORK, U.S.A.

Highway Engineering Division. The firm will continue its practice of general consulting engineering under the name of Seelye Stevenson Value & Knecht.

Raymond S. Hoffman has been elected to the board of directors of Walter Kidde Engineers Southwest, Inc., according to an announcement by William Collins, president of Walter Kidde Constructors, Inc.

HOFFMAN

DUFFY

Joseph J. Duffy, Jr., of Villanova, Pa., formerly manager of Pennsalt Chemical Corporation's Metal Processing Department, has joined the staff of Kain & Hooven, Consulting Engineers, Lansdowne, Pa. Duffy's 20 years of sales engineering experience will be used to advantage by this firm, which specializes in engineering services to the architectural, industrial, and construction fields.

An autographing party in honor of W. F. Smith, partner in Howe & Wise, Consulting Engineers, Houston, to celebrate his new book, *Diamond Six*, will be held on June 6 at Conroe, Texas. Fifty thousand invitations have been sent out for the gathering. *Diamond Six* is the story of one of Texas' oldest cattle ranches, started by Mr. Smith's grandfather.

Foster D. Snell, Inc., consulting chemists and chemical engineers, of New York City, have purchased the consulting firm of Davis & Bennett, Inc., Worcester, Mass. Benjamin Seibel has been named laboratory director of the Davis & Bennett Division. ▲▲

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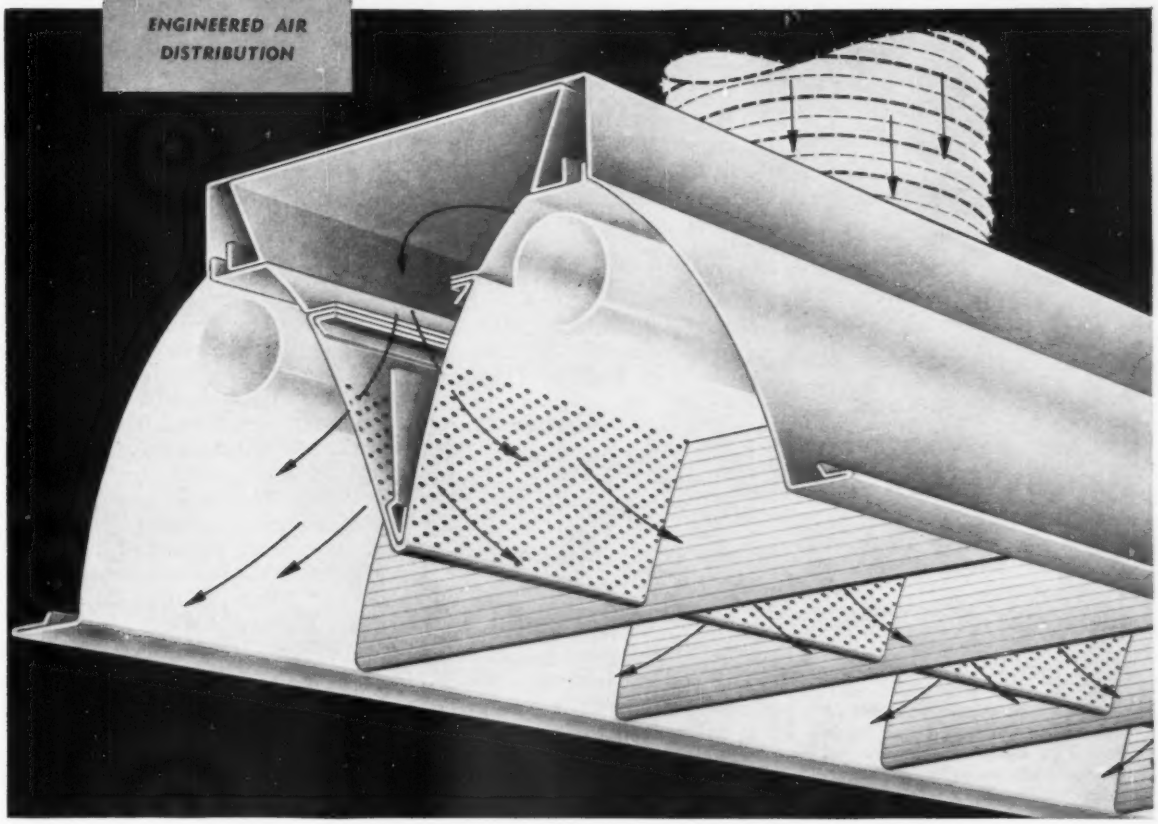
ENGINEERED AIR DISTRIBUTION

For engineered air distribution combined with high-comfort lighting

PARAFLO

by Day-Brite and Barber-Colman



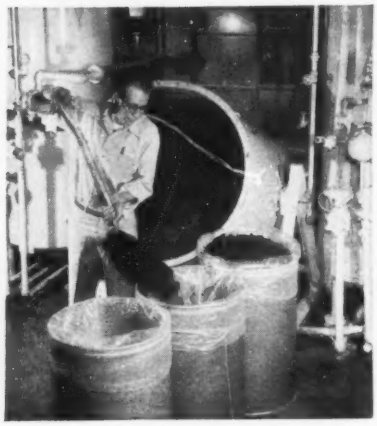
If your plans call for a combination light and air distribution fixture, specify the new Paraflo. It's the one troffer combining precision-engineered air diffusion and high-comfort illumination in a single attractive unit. Developed jointly by Day-Brite Lighting, Inc., and Barber-Colman Company air distribution engineers, the Paraflo provides properly diffused air throughout the length of its exclusive center "V" louver. Controlled lateral deflection of the quiet, diffused air stream eliminates "waterfall" effect without ceiling smudge. The Barber-Colman air volume control is adjustable from below after installation for simplified system balancing. For more details on this newest and most efficient combination fixture, call your nearby Barber-Colman field office or write to . .

BARBER-COLMAN COMPANY

Dept F, 1160 Rock Street, Rockford, Illinois

One source . . . one responsibility for *both* air distribution and automatic controls

ILLCO-WAY
ionXchange
PACKING SPECIAL RESIN AT ILLCO PLANT



NUCLEAR GRADE
EXCEPTIONALLY PURE
SUPER-REGENERATED
RESINS

ILLCO Nuclear Grade Resins are specially treated to remove the organic matter and inorganic materials which are found in ordinary ion-exchange resins, after which treatment they are super-regenerated on any selected cycle. Nuclear Grade Resins are suitable for research and process applications where higher-than-ordinary purity of the resin is required. Nine standardized types are available, and special types can be produced on request.

USED AT SHIPPINGPORT
ILLCO Nuclear Grade Resins are used to purify water used for heat transfer and shielding at the great new pioneering atomic energy power plant at Shippingport, Pa., a joint project of the Atomic Energy Commission and Duquesne Light Company of Pittsburgh.

WRITE FOR THIS DATA SHEET
Gives information on all types of Technical and Nuclear Grade Resins, together with clear illustrations of important ILLCO color indicator.

ILLCO-WAY
ILLINOIS WATER TREATMENT CO.
840 Cedar St.
Rockford, Ill.
NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANDIAN DIST.: Pumps & Softeners, Ltd., London, Ont.

New Projects Reported

By Consulting Engineers

ARIZONA

John E. Stephens & Associates
Phoenix, Arizona
¶ 20-million gallon water reservoir, Phoenix, Ariz. (civil, struc.) $400,000. Client, City of Phoenix, Ariz.
¶ Miscellaneous highway bridges, U. S. Route 70, near Safford, Ariz. (civil, struc.) $300,000. Client, Arizona State Highway Department, Phoenix, Ariz.
¶ High school facilities, Fort Defiance, Ariz. (civil, struc., mech., elec.) $723,000. Client, School District No. 8, Apache County, Ariz.
¶ Elementary school facilities, Kayenta, Ariz. (civil, struc., mech., elec.) $756,100. Client, School District No. 27, Navajo County, Ariz.
¶ Miscellaneous facilities and structures, Navajo Indian Reservation, Ariz. (civil, struc., mech., elec.) $7.5 million. Client, The Navajo Tribe, Window Rock, Ariz.
¶ High school facilities, Tuba City, Ariz. (civil, struc., mech., elec.) $803,400. Client, School District No. 15, Coconino County, Ariz.
¶ Elementary school additions, Tuba City, Ariz. (civil, struc., mech., elec.) $450,000. Client, School District No. 15, Coconino County, Ariz.

James E. Hastain
Phoenix, Arizona
¶ Extension of water mains at Phoenix. (civil) $200,000. Client, City of Phoenix, Ariz.
¶ Streets, paving, curbs, and gutters. (civil) $50,000. Client, St. Francis Improvement District, Maricopa County, Ariz.
¶ National Guard Armory, Douglas. (struc., mech., elec.) $185,000. Client, National Guard Armory, Phoenix, Ariz.

Williams-Hastain
Phoenix, Arizona
¶ Sanitary trunk sewer line, 5½ miles, Phoenix, Ariz. (civil) $298,000. Client, City of Phoenix.

CALIFORNIA

Wilsey & Ham & George S. Erskine
Milbrae, California
¶ Exhibit building for San Mateo County fair and fiesta. (civil, struc., mech., elec.) $45,000. Client, County of San Mateo.

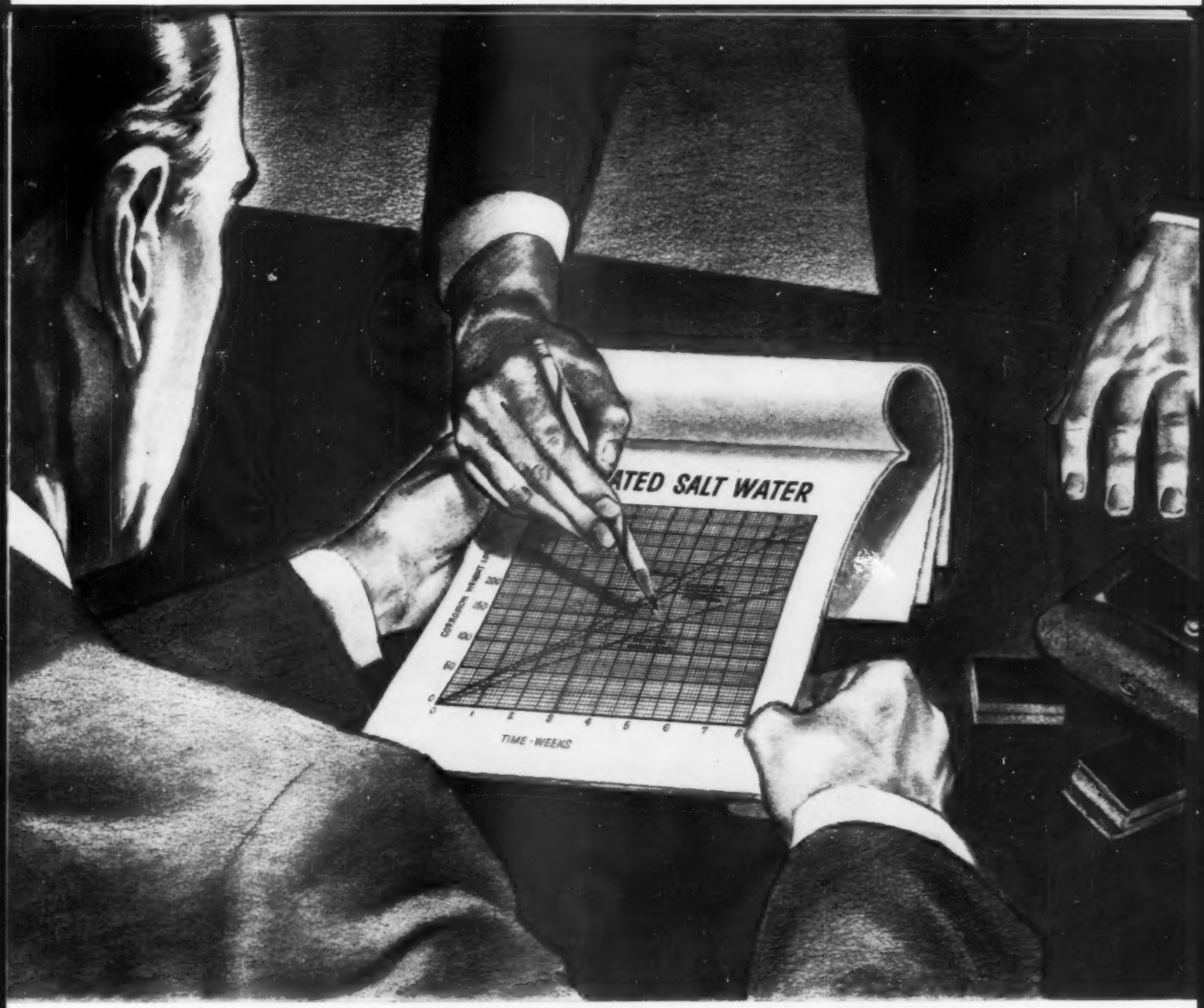
Floyd E. Weaver
Santa Ana, California
¶ Hyperbolic paraboloid, 100 x 150-ft, transversely prestressed, Tustin, Calif. (struc.) $60,000. Client, Baptist Church of Tustin.

Leo W. Ruth, Consulting Engineer
Modesto, California
¶ Feasibility report — municipal and private water systems in and adjacent to city. (civil) Client, City of Modesto, Calif.

Sabin Engineers
San Francisco, California
¶ Ship loading facilities, Stockton Elevators, Stockton, Calif. (mech.) $50,000. Client, Port of Stockton.

King, Benioff & Associates
Sherman Oaks, California
¶ Ventura College music and arts building, auditorium, stage, workroom, and practice rooms. (struc.) $500,000. Client, Architect, Harold Burket, Ventura, Calif.

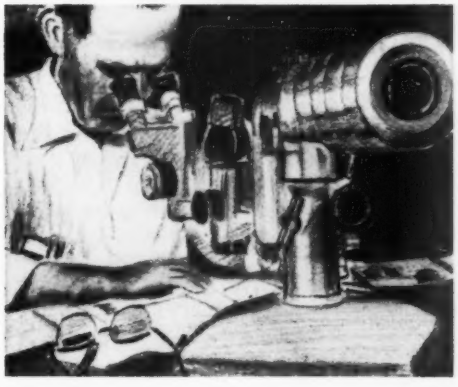
Cline, Zerkle & Agee
Berkeley, California.
¶ Office and warehouse, North Sacramento, Calif. (civil, struc., mech.,



A Byers field service representative can relate new 4-D Wrought Iron test results to the specifier's corrosive applications.

Laboratory and field test results lend added support to 4-D Wrought Iron specs

Our metallurgical staff compiles and analyzes great funds of data on corrosion-resistant materials.



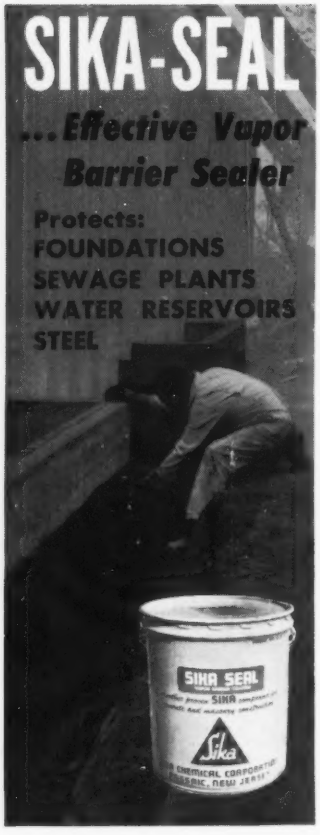
With some products, a company representative's natural enthusiasm is often *tempered* by actual test results in the laboratory.

Not so however, with new 4-D Wrought Iron. Byers field service engineers can present research facts which confirm the increased corrosion-resistance of this new product.

Comparative testing with standard Wrought Iron, as well as many ferrous substitutes, proves new 4-D Wrought Iron a decidedly superior deterrent to corrosion. So the wisdom of standard Wrought Iron specifications may now be further enhanced by specifying new 4-D Wrought Iron.

Byers field service engineers are lending even more credibility to this story with their own knowledge of corrosive infighting. The Byers representative will welcome an opportunity to relate these test results to your corrosive applications. Call him soon. Or, write us for helpful literature on new 4-D Wrought Iron. A. M. Byers Company, Clark Building, Pittsburgh 22, Pa.

BYERS WROUGHT IRON



Sika-Seal forms a tough, flexible and durable coating that provides an immediate vapor barrier when applied to structural materials.

It protects concrete, mortar, steel and other metallic and non-metallic surfaces. With Sika-Seal, your structure is protected from attacks by water, salt, dilute acids, mild alkalies and sea water — because Sika-Seal resists them all!

Moreover, Sika-Seal is a proven time and money saver since it can be painted directly on either damp or dry surfaces without delaying backfill operations.

In short, Sika-Seal is the ideal protection for wherever control of moisture, condensation and corrosive vapor is a must. For complete information on Sika-Seal, write or wire for Bulletin SS-58.

Sika SIKA CHEMICAL CORPORATION
PASSAIC, NEW JERSEY

DISTRICT OFFICES: ATLANTA • BOSTON • CHICAGO • DALLAS • DETROIT • NEW ORLEANS • PHILADELPHIA • PITTSBURGH • SALT LAKE CITY • WASHINGTON—DEALERS IN PRINCIPAL CITIES—AFFILIATES AROUND THE WORLD

elec.) $150,000. Client, National Biscuit Co.
¶ Furniture warehouse, South San Francisco, Calif., (civil, struc.) $600,000. Client, Sterling Furniture.
¶ Warehouse, North Sacramento, Calif. (civil, struc., mech., elec.) $120,000. Client, W. J. Burke Co.

COLORADO

M. S. Wilson
Denver, Colorado
¶ Lakewood senior high school. (mech.) $265,000 (mech.). Client, Jefferson School District.
¶ Wheatridge senior high school. (mech.) $265,000 (mech.). Client, Jefferson School District.
¶ West Lakewood Elementary school. (mech.) $60,000 (mech.). Client, Jefferson School District.

Miner and Miner, Consulting Engineers, Inc.
Greeley, Colorado
¶ 115-12.5 kv substation near Woodrow, Colo. $100,000. Client, Morgan County Rural Electric Association, Fort Morgan, Colo.
¶ 22 miles of electric distribution extensions near Salida. Colo. $80,000. Client, Sangre De Cristo Electric Association, Salida, Colo.

Ken R. White
Denver, Colorado
¶ Pueblo Colorado Memorial Airport. Reconstruct runways, new taxiways, and airfield lighting. (civil) $1.2 million. Client, City of Pueblo.

CONNECTICUT

Fred S. Dubin Associates
Hartford, Connecticut
¶ Hartford College classroom building and laboratory, Hartford, Conn. (heating, ventilating, plumbing, electrical) $250,000. Client, Huntington & Darbee, Arch.
¶ St. Barnabas Episcopal Church, Greenwich, Conn. (heating, ventilating, plumbing, electrical) $150,000. Client, Philip Ives, Arch.
¶ Special laboratories for New Britain Memorial Hospital, New Britain, Conn. (heating, ventilating, plumbing, electrical, air conditioning) $1.7 million. Client, H. F. Ludorf, Arch.
¶ Special watering systems for State of Connecticut Tobacco Laboratory, Windsor, Conn. (heating, ventilating, plumbing, electrical) $40,000. Client, Raymond Brown, Arch.
¶ University of Connecticut Music Hall, Storrs, Conn. (heating, ventilating, plumbing, electrical) $300,000. Client, Golden-Storrs Associates, Arch.
¶ Laboratory layout for State of Connecticut Virus Laboratory, Hartford, Conn. (heating, ventilating, plumbing, air conditioning, electrical) $60,000. Client, Raymond Brown, Arch.
¶ State of Connecticut highway office building, Norwich, Conn. (heating, ventilating, plumbing, electrical, sanitary) $600,000. Client, Pomerance & Breines, Arch.

FLORIDA

James L. Gay, Consulting Engineer
Orlando, Florida
¶ Two-story, 65,000-sq ft state agency office building, Winter Park, Fla. (mech., elec.) $850,000. Client, Board of Commissioners of State Institutions of State of Florida, owner, Hugo R. Broleman, Jr., Arch.

Wesley Bintz, P.E.
Lansing, Michigan
¶ Community pool and bathhouse. (civil) $150,000. Client, City of Key West, Fla.

George A. Gieseke
Philadelphia, Pennsylvania
¶ Sanitary sewers ($50,000) and water distribution ($30,000), Plantation Park, 2nd addition, Florida. (civil) Client, Wells Development Co., Plantation, Fla.
¶ Drainage and irrigation pumping facilities, along Snake Creek 5 miles west of Plantation, Fla. (civil, mech., elec.) $60,000. Client, Wells Development Co., Plantation, Fla.

C. B. Arbogast, Jr.
Stuart, Florida
¶ Prestressed concrete bridge. (civil) $30,000. Client, North River Shores, Inc.

Frederick L. Bell & Associates, Inc.
Tallahassee, Florida
¶ Highway needs report including state primary and secondary system, major county roads, and prin-

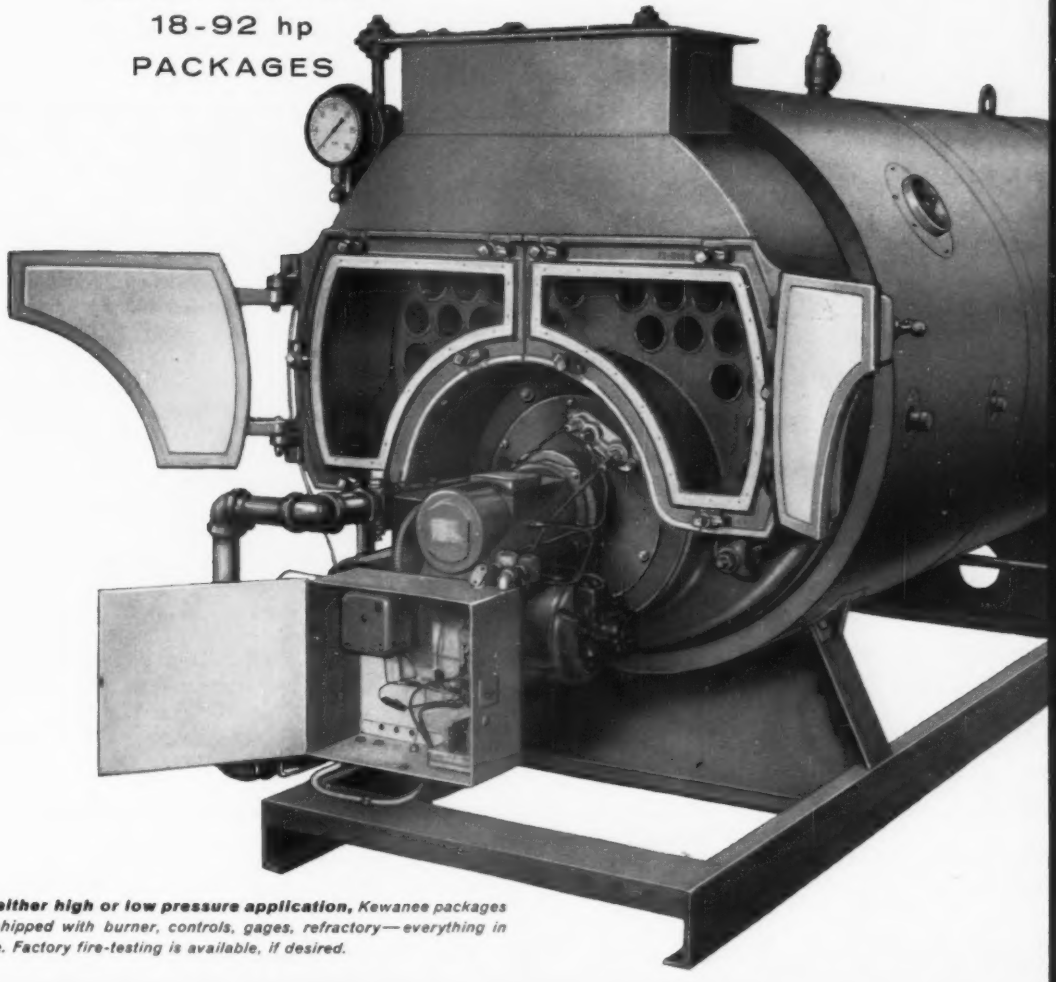
NEW . . . AND *NEEDED*

KEWANEE®

READY-TO-FIRE

18-92 hp

PACKAGES



For either high or low pressure application, *Kewanee packages are shipped with burner, controls, gages, refractory—everything in place. Factory fire-testing is available, if desired.*

Put Kewanee quality and the package principle together on your next "under 100 hp" project. If it's a high pressure job, choose from 8 packages ranging from 18 to 92 hp. For low pressure applications, Kewanee packages start at 606,000 Btuh and end, eight sizes later, at 3,091,000 Btuh.

These are famous Kewanee Scottie Jr. Boilers factory-teamed with Kewanee Burners for oil, gas or combination oil-gas firing. They arrive on the job ready to fire as soon as they are connected to fuel, water, steam, power and vent. Fuel changeover, in combination firing, is fast and can even be handled by automatic controls. Forced-draft firing eliminates a stack. No unit is higher than an 8-foot standard ceiling.

New literature has recently come off the press on these new Kewanee packages. If you haven't seen it, send the coupon at right to: AMERICAN-STANDARD, KEWANEE BOILER DIVISION, 109 Franklin Street, Kewanee, Illinois.

American-Standard
Kewanee Boiler Division
109 Franklin Street • Kewanee, Illinois

KEWANEE 1868 1958 90th year

Please supply literature on the following Kewanee Boilers:

☐ high pressure . . 18 to 92 hp, 125-150 lb wp

☐ low pressure . . . 606 to 3091 MBtuh, 15 lb steam - 30 lb water

Name _____

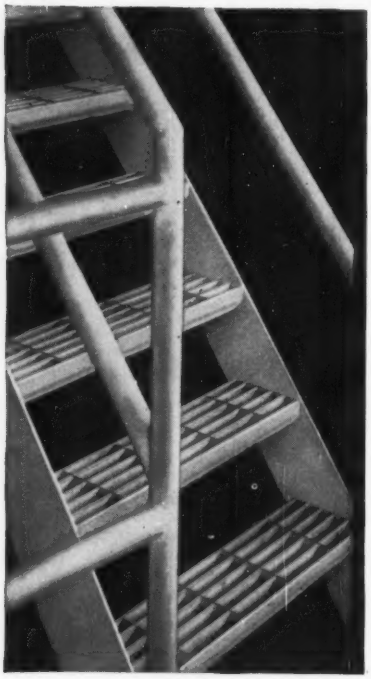
Firm _____

Street _____

City _____ Zone ____ State _____ 6

AMERICAN-Standard

KEWANEE BOILER DIVISION



SHUR-SITE TREADS

...the best step for

SAFETY

Hendrick Shur-Site Treads have a non-slip surface that *insures* safety, making them the best choice for your stairs, ladders and fire-escapes. A heavy nosing bar provides reinforcement where the load is greatest. Shur-Site Treads are constructed by a pressure forming process, and so have no angle irons, bolts or rivets to collect dirt and refuse. Their 90% open area lets in plenty of light and air.

Shur-Site Treads are available in standard sizes or in special widths and lengths. They are shipped ready to bolt directly to stair stringers.

Hendrick

MANUFACTURING COMPANY
42 DUNDAFF STREET, CARBONDALE, PA.
Sales Offices in Principal Cities

cipal arterial urban connecting links through municipalities for Pinellas County, Fla., and the Florida State Road Department. (civil) $25,000. Client, Pinellas County, Fla. and State Road Department, Florida.

GEORGIA

Dan E. Swell and Associates
Savannah, Georgia
¶ Sanitary sewers, storm sewers, clearing, grading, paving of roads, East Savannah subdivision and various short streets. (civil) $190,000. Client, City of Savannah.

Schmidt Engineering Company, Inc.
Chattanooga, Tennessee
¶ Interceptor sewer. $150,000. Client, Rossville, Ga.

IDAHO

Cornell, Howland, Hayes & Merryfield
Boise, Idaho
¶ Study and design of sewers and sewage treatment facilities, Twin Falls, Idaho. (civil, struc., mech., elec.) $1 million. Client, City of Twin Falls, Idaho.

ILLINOIS

A. Epstein and Sons, Inc.
Chicago, Illinois
¶ Warehouse addition, Melrose Park, Ill. (civil, struc., mech., elec.) $900,000. Client, Jewel Tea Co., Inc.
¶ Warehouse addition, Chicago, Ill. (civil, struc., mech., elec.) $3.5 million. Client, Campbell Soup Co.
¶ Medical Research Institute, Chicago, Ill. (civil, struc., mech., elec.) $3 million. Client, Chicago Medical School.
¶ Warehouse addition, Barrington, Ill. (civil, struc., mech., elec.) $1,250,000. Client, Jewel Tea Co., Inc.
¶ Community center building, Chicago, Ill. (civil, struc., mech., elec.) $2 million. Client, Jewish Community Centers.
¶ Hospital, Chicago, Ill. (struc., civil, mech., elec.) $4 million. Client, West Towns Hospital.

Fred S. Dubin Associates
Hartford, Connecticut
¶ Heating and ventilating consultation for IBM office building, Chicago, Ill. Client, Eliot Noyes, Arch.
¶ Hyde Park development, Chicago, Ill. (heating, ventilating, plumbing, electrical, air conditioning) $8 million. Client, I. M. Pei & Associates, Architect.

Thulin, Woods & Isensee
Chicago, Illinois
¶ 120-unit apartment hotel, Evanston, Ill. (arch., struc., mech., elec.) $1 million (est.). Client, Bright, Hurwith & Zaltzman.

Russell & Axon
St. Louis, Missouri
¶ Diesel engine generator installation (addition to present plant). (mech.) $225,000. Client, City of Red Bud, Ill.
¶ Sewage treatment plant improvements and extensions. (civil, struc., mech.) $300,000. Client, City of Belleville, Ill.

INDIANA

A. Epstein and Sons, Inc.
Chicago, Illinois
¶ Department store, Fort Wayne, Ind. (civil, struc., mech., elec.) $3.6 million. Client, Wolf & Dessauer.
¶ Department store addition, South Bend, Ind. (civil, struc., mech., elec.) $1 million. Client, Robertson's department store.

Southern Engineering Company
Louisville, Kentucky
¶ Greyhound terminal and parking, Indianapolis, Ind. (mech., elec.) $3 million (est.). Client, Arrasmith & Tyler, Arch.
¶ Hayden School, Hayden, Ind. (mech., elec.) $500,000. Client, Walker, Applegate, Oakes and Ritz, Architect.

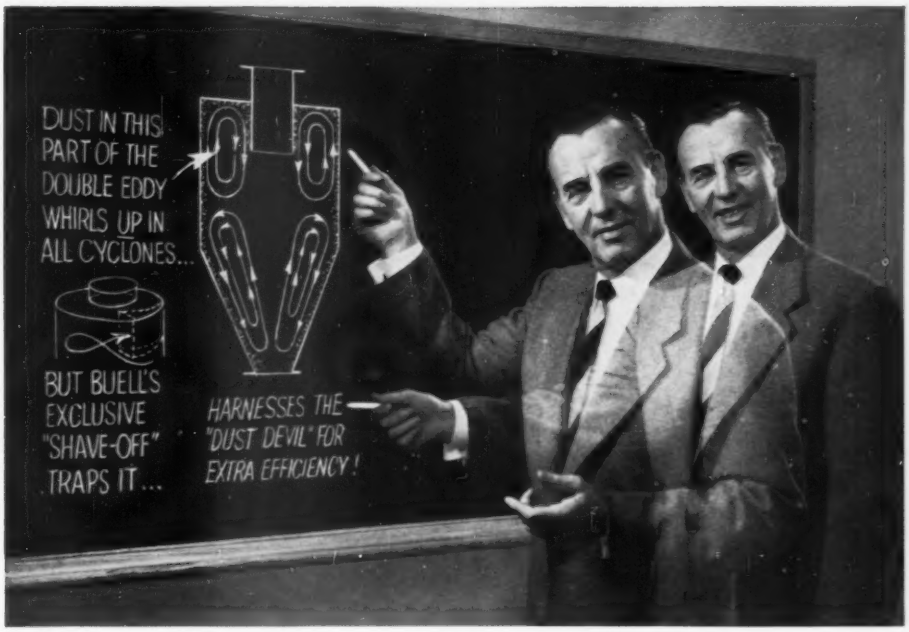
IOWA

Fred S. Dubin Associates
Hartford, Connecticut
¶ St. Henry's dormitory, Davenport, Iowa. (heating, ventilating, plumbing, electrical) Client, Murphy & Mackey, Arch.

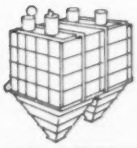
KANSAS

Uri Seiden & Associates
Kansas City, Missouri
¶ Post office building, Leavenworth,

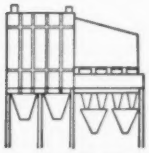
Mastering the double-eddy dust devil leads to extra dust collection efficiency!


DUST IN THIS PART OF THE DOUBLE EDDY WHIRLS UP IN ALL CYCLONES...
BUT BUELL'S EXCLUSIVE "SHAVE-OFF" TRAPS IT...
HARNESSES THE "DUST DEVIL" FOR EXTRA EFFICIENCY!

BUELL CYCLONES



"SF" ELECTRIC PRECIPITATORS



PRECIPITATOR-CYCLONE COMBINATIONS

Only Buell Cyclones have the "Shave-off" that removes the fines carried in the double-eddy currents, minimizes reentrainment, assures measurably higher dust collection efficiency! Other exclusive extra-efficiency features include *large-diameter* design that eliminates bridging and clogging, proper proportioning for maximum dust separation from the gas stream, extra-heavy-gauge, wear-resistant construction, Buell-designed manifolding that minimizes draft loss, minimizes scouring and eddying. For more information send for a copy of the booklet, "The Exclusive Buell Cyclone." Dept. 47-E, Buell Engineering Company, Inc., 123 William Street, New York 38, N. Y.

buell®

Experts at delivering Extra Efficiency in **DUST COLLECTION SYSTEMS**

AirMeter

LO-BOY
CENTRIFUGAL
ROOF EXHAUSTERS

Enhance The Beauty Of Building Skylines

Pats. Pend.

Lowest Silhouette Design

FORWARD OR BACKWARD CURVE WHEEL WITHIN . . . . OR OUT OF SCROLL HOUSING

Motor mounting on side of structure support . . . out of line of air stream reduces height of Lo-Boy models nearly 50% of older designs.

LOW WIND RESISTANCE SIZES 10"-72"
600-47,000 CERTIFIED C.F.M. RATINGS

● QUALITY ● BEAUTY
● PROVEN PERFORMANCE

See Sweet's File 20c/Amm or Write for bulletin CE100 58

AMMERMAN CO., INC.

110 North Second St.
Minneapolis 1, Minnesota

MEMBER OF THE AIR MOVING & CONDITIONING ASSN.

Kans. (struc.) $1 million. Client, Tewksbury & Assoc., Arch.

KENTUCKY

Southern Engineering Company
Louisville, Kentucky

¶ Fort Knox elementary school #4, Fort Knox, Ky. (mech., elec.) $704,000. Client, William G. Crawford, Architect.

¶ Beargrass Christian Church addition, Louisville, Ky. (mech., elec.) $300,000. Client, Thos. J. Nolan & Sons, Arch.

¶ Puritan apartment addition, Louisville, Ky. (mech., elec.) $250,000. Client, Joe Haas, Contractor.

¶ Fort Knox Chapel, Fort Knox, Ky. (mech., elec.) $200,000. Client, Stratton O. Hammon, Arch.

J. Stephens Watkins
Lexington, Kentucky

¶ New 1.5-mgd water treatment plant. (civil) $369,000. Client, City of Pikeville, Ky.

¶ Preliminary work for additional sewers, 1-mgd primary type sewage treatment plant, and additional water mains. (civil) $820,000. Client, City of Pikeville, Ky.

¶ 1-mgd addition to 2.5-mgd water treatment plant. (civil) $129,000. Client, City of Danville, Ky.

¶ Sanitary sewer additions. (civil) $152,000. Client, City of Danville.

¶ Additional sewer work. (civil) $100,000. Client, City of Danville.

¶ Additional sanitary sewers and interceptor sewer and sewage treatment plant or plants to serve 40,000 persons plus several industries. (civil) $3,750,000. Client, City of Ashland, Ky.

¶ Plans and specifications for 170,000-gpd sewage treatment plant. (civil) $420,000. Client, City of Eminence, Ky.

¶ Plans and specifications for industrial waste treatment of chromium and oil wastes for Naval Ordnance Plants, Louisville, Ky. (civil) $185,000. Client, U.S. Navy.

¶ 600,000-gpd sewage treatment plant. (civil) $294,000. Client, Bardstown, Ky.

¶ Preparation of report recommending sewage treatment plant and additional sanitary sewers. (civil) $507,000. Client, Carrollton, Ky.

¶ 1-million gallon storage tank for U. S. Public Health Service Hospital, Lexington, Ky. (civil) Client, U. S. Public Health Service.

MASSACHUSETTS

A. Epstein and Sons, Inc.
Chicago, Illinois

¶ Grocery warehouse and related facilities, Boston, Mass. (civil, struc., mech., elec.) $3 million. Client, Stop & Shop.

MICHIGAN

Southern Engineering Company
Louisville, Kentucky

¶ Greyhound terminal and parking garage, Detroit, Mich. (mech., elec.) $5 million. Client, Arrasmith & Tyler, Arch.

Pate & Hirn, Inc.
Detroit, Michigan

¶ Grosse-Gratiot drain. Inter-county drain project located in Harper Woods, Grosse Pointe Woods, and St. Clair Shores in Wayne and McComb counties, Mich., consisting of storm relief sewers, pumping station, storm water treatment plant, and cleaning, deepening, and widening Milk River to Lake St. Clair. Joint project with George Jerome & Co. (civil) $11 million (est.). Client, Inter-County Drainage Board of Wayne-McComb Counties.

¶ Storm relief sewer project, city wide, including one new pumping station. (civil) $2.5 million. Client, City of Lincoln Park.

MISSOURI

Russell & Axon
St. Louis, Missouri

¶ Water supply reservoir, supply main, and filter plant. (civil, struc.) $340,000. Client, City of Vandalia.

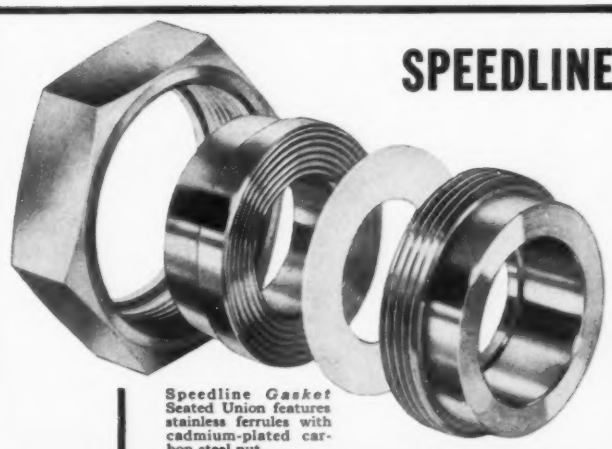
Fred S. Dubin Associates
Hartford, Connecticut

¶ St. Gregory's Church, St. Annes, Mo. (heating, ventilating, plumbing, electrical) Client, Murphy & Mackey, Arch.

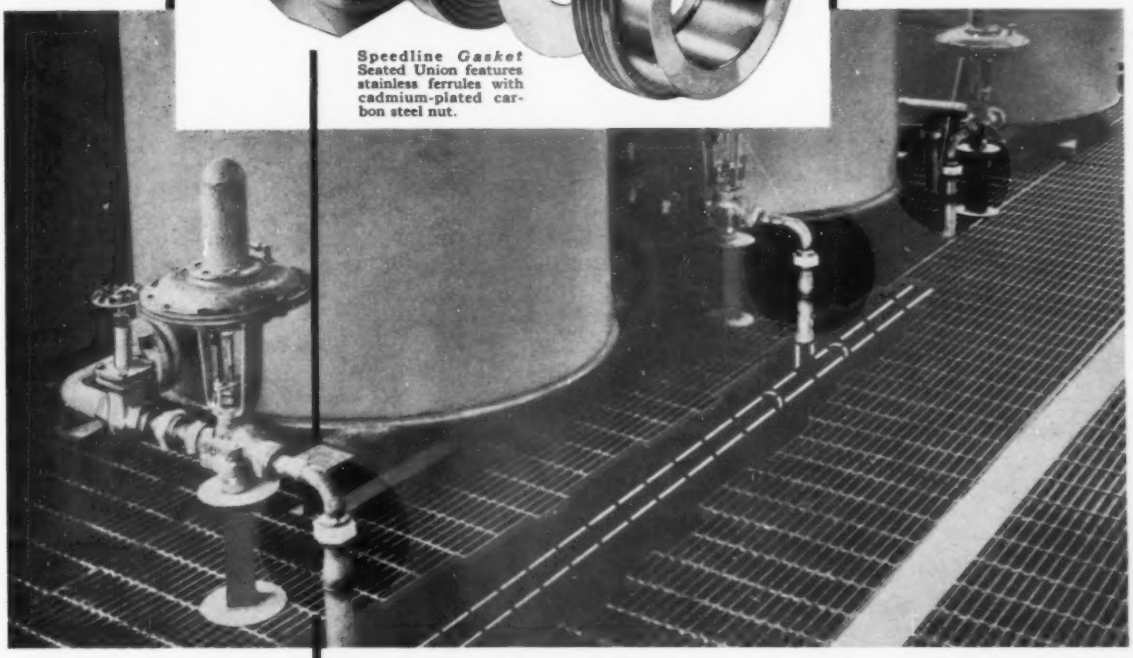
Williamson & Associates
St. Louis, Missouri

¶ Surveys, report, recommendations; garbage collection and disposal. Studies involve composting,

SPEEDLINE FITTINGS SOLVE LEAKAGE AND ASSEMBLY PROBLEMS



Speedline *Gasket* Seated Union features stainless ferrules with cadmium-plated carbon steel nut.



Here's the stainless steel union to eliminate troublesome ground joints. The Speedline Union is *gasket seated* to eliminate leakage . . . *bi-metallic* to permit easy disassembly and make-up *without* galling or seizing. It's available in two styles . . . for welding or expanding to low cost Schedules 5 and 10 pipe and the complete line of Speedline fittings.

Advantages of Speedline Unions simplified piping problems at American Alcolac's Baltimore plant . . . permits ready removal of process lines located beneath floor grating when necessary. Use of Speedline Fittings throughout the plant's piping system reduced labor and materials costs to a minimum . . . maintained high degree of process purity demanded in process operations.

The *complete line* of Speedline Fittings with the exclusive "extra length" feature, offer many assembly advantages and cost savings not possible with conventional fittings. Request your copy of Speedline Catalog today.

Speedline®

SPEEDLINE IS A REG.T.M. OF HORACE T. POTTS COMPANY

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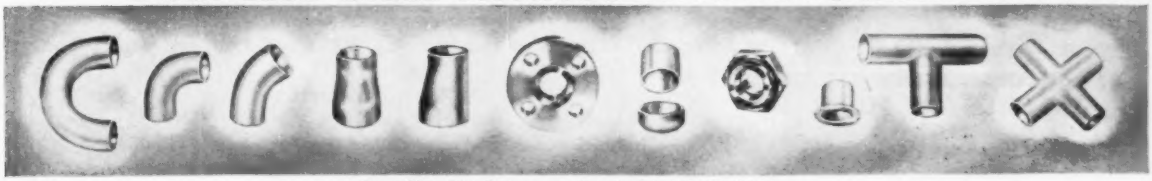
STAINLESS STEEL FITTINGS—FOR THE ULTIMATE IN PROCESS PIPING EFFICIENCY



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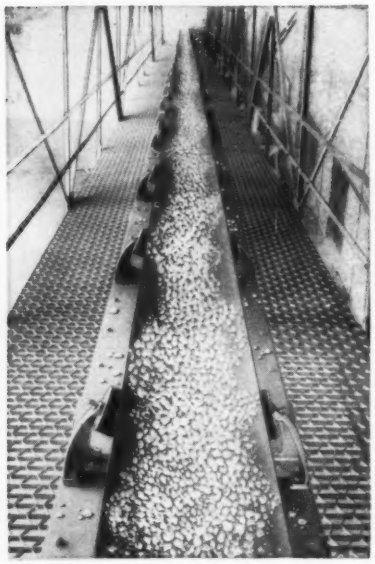
Spilled materials on a solid walkway caused workmen to stumble and turn ankles. Installation of 80% open Irving Mesh Grating allowed materials to fall through and minimized the hazard.



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incineration, hog feeding, land fill, and miscellaneous. (civil) Client, City of St. Louis, Mo.

Uri Seiden & Associates
Kansas City, Missouri
¶ Hyperbolic paraboloid shell park shelters, Jackson County Lake Park, Mo. (struc.) $30,000. Client, Jackson County, Mo.
¶ Hyperbolic paraboloid shell park shelters, Kansas City, Mo. (struc.) $18,000. Client, Kansas City, Mo.
¶ Grade school building, Hickman Mills, Mo. (struc.) $500,000. Client, Franckiser & Hutchens, Arch.

NEBRASKA

Raymond H. Reed & Company
Columbus, Nebraska
¶ 34.5 kv transmission line, 8 miles, in Platte County, Nebr. (elec.) $50,000. Client, Cornhusker Rural Public Power District, Columbus, Nebr.
¶ 11.0 miles of 34.5 kw transmission line in Hall County, Nebr. (elec.) $60,000. Client, Southern Nebraska Rural Public Power District, Grand Island, Nebr.

NEW JERSEY

De Leuw, Cather & Brill
New York, New York
¶ Surveys, contract plans, estimates, and specifications for 11½ miles of limited access highway, including 18 grade separations and 3 interchanges. Interstate Route FAI 102, Somerset County, N.J. (civil, struc.) $18 million. Client, State Highway Department of New Jersey.

David R. Wittes
Philadelphia, Pennsylvania
¶ Penn Fruit shopping center, Haddonfield, N. J. (civil, struc.) $250,000. Client, Sabatino & Fishman, Architects.
¶ Mount Airy community center. (civil, struc.) $250,000. Client, S. I. Oshiver, Arch.

H. G. Metzger, Jr. & Associates
Huntingdon Valley, Pennsylvania
¶ Extension of fire mains and alterations to ventilating systems, Woodbine State Colony for Feeble Minded Males, Woodbine, N. J. (mech.) $12,000. Client, A. Clauss, Arch.
¶ Heating, plumbing, and air conditioning, Pestcoe residence, Trenton, N. J. (mech.) $35,000. Client, Franklyn B. Spiezle, Arch.
¶ Heating and plumbing for school additions, Evangelical Lutheran Church of the Holy Trinity, Wildwood, N. J. (mech.) $70,000. Client, Charles M. Talley, Arch.

A. Epstein and Sons, Inc.
Chicago, Illinois
¶ Building for manufacturing and storing vinyl tile, So. Plainfield, N.J. (civil, struc., mech., elec.) $300,000. Client, Kentile, Inc.

NEW MEXICO

Bridgers and Paxton
Albuquerque, New Mexico
¶ Pius X High School, Albuquerque, N. M. (mech.) $3 million. Client, Stanley & Wright.
¶ Petroleum office building, Santa Fe, N. M. (mech.) $1 million. Client, W. C. Kruger & Assoc., Arch.
¶ Huelsman Medical Building, Albuquerque, N. M. (mech.) $60,000. Client, W. W. Ellison, Arch.
¶ Addition to Science Building, Highlands University, Las Vegas, N. M. (mech.) $300,000. Client, Meem, Holien, Buckley & Assoc., Architect.

Dr. Marcello Giomi & Associates
Albuquerque, New Mexico
¶ Elementary school, Roswell, N.M. (mech.) $270,000. Client, Frank M. Standhardt, Arch.
¶ St. Helen Parish group, Hobbs, N.M. (mech.) $220,000. Client, Frank M. Standardt, Arch.
¶ Music and band buildings, Clovis High School, Clovis, N.M. (mech.) $175,000. Client, James A. Burran, Architect.
¶ San Jose school and convent, Albuquerque, N. M. (mech.) $200,000. Client, Burwinkle & Milner, Architects.

NEW YORK

Fred S. Dubin Associates
Hartford, Connecticut
¶ Bedford Hills fire house, Bedford Hills, N. Y. (heating, ventilating, plumbing, electrical) $256,000. Client, Matthew J. Warshauer, Arch.
¶ Oneida National Bank & Trust Co., Utica, N. Y. (heating, ventilat-

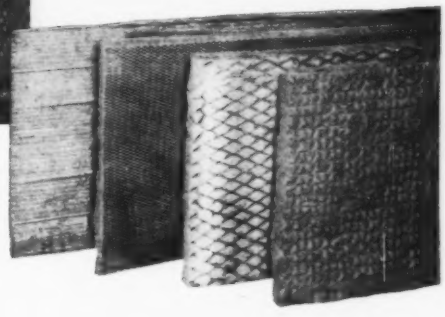
DETROIT EDISON COMPANY
Wraps up an Insulation Problem . . . with 4 inch

BALDWIN-HILL
Spun Mineral Fiber
BLANKETS

When Detroit Edison wanted to insulate the boiler water walls of their River Rouge power plant, they selected B-H spun mineral fiber Blankets, 4″ thick, to obtain the required thermal efficiency.

B-H Blankets, size 2′ x 8′, were particularly adaptable to covering the 8′ high areas of the boiler skin casing. These blankets are B-H Style No. 2A with 1″ wire mesh on the inner face and expanded metal lath on the outside. They were impaled over studs welded to the boiler skin casing and laced tightly together to form an unbroken layer of insulation. The blankets were later protected with a shell of aluminized sheet metal panels.

B-H Mono-Block also was used to insulate all heated fan housings as well as air and gas ducts; all joints were pointed with B-H Improved Super Powerhouse Cement.



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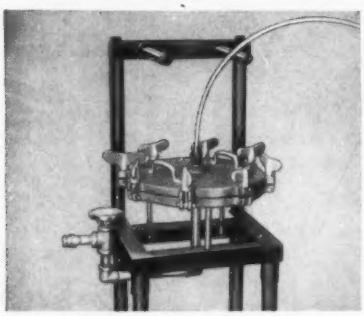
Kalamazoo, Mich. . . . Huntington, Ind. . . . Temple, Tex.

For more information on these products as well as other B-H Insulations, write for 1958 catalog—or see it in Sweet's Plant Engineering File.

NEW PRODUCT

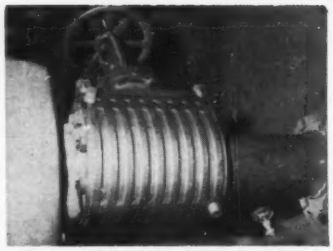


BARNSTEAD "MF" SUBMICRON FILTER FOR REMOVAL OF PARTICLES TO 0.45 MICRON

This new Barnstead "MF" Submicron Filter for either distilled or demineralized water, has been developed to remove submicroscopic particulate matter which may cause trouble in some of the new processes in electronic and nucleonic fields. The Barnstead "MF" Submicron Filter will filter out particles as small as .000016 inches, thus permitting a filtering technique not before possible on a production basis.

Each Barnstead "MF" Filter plate can filter up to 100 gallons per hour. Multiple plates can be employed to obtain larger flow rates.

Write for new bulletin #141 to the Barnstead Still & Demineralizer Company, 44 Lanesville Terrace, Boston 31, Massachusetts.



This VALVE WARMER, RECENTLY ANNOUNCED,

is receiving much favorable attention by engineers. See our ad page 198 in the April 1958 issue of CONSULTING ENGINEER where we show how the

DEAN THERMO-PANEL COIL

is made. By curving a Dean Panel around a valve, as shown above, we have a VALVE WARMER, often desired for various uses where warmth is needed for the maintenance of flow of viscous fluids and liquids, such as wax, asphalt, petroleum, glycerine, etc. The cost is usually much lower. Lighter in weight. Occupies less space. Simpler. More economical. No electrical hazards. The saving in time for installing makes it a decidedly preferred device. For complete data ask for Form V-2. Also, Bulletin 355—52 pages—gives full technical information on the Dean Thermo-Panel Coil for many purposes. Bulletin 258 gives design and price data. Ask for any or all, and, if you want help on pipe heat transfer problems, call on our specialists.

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DEAN THERMO-PANEL COIL DIVISION
DEAN PRODUCTS, INC. 618 Franklin Ave.
BROOKLYN 38, N. Y. Tel. STerling 9-5400

ing, air conditioning, plumbing, electrical) $1 million. Client, Alfred Easton Poor, Arch.

Emil Domingo, P.E.
New York, New York
¶ Design of special (plastic) valves, gaskets, and fittings for food and dairy pipeline. (mech.) $20,000. Client, Nucio Mold Products, Yonkers, N. Y.
¶ Installation of mechanical system for cleansing pipes and tanks. (mech., elec.) $45,000. Client, Dellwood Dairies, Yonkers, N. Y.

Gennaro Mianulli
Brooklyn, New York
¶ St. Vincent doctors' hospital, Brooklyn, N. Y. (struc.) $200,000. Client, D. Salvati & Son, Arch.
¶ Nursing home, Bayville, Long Island. (struc.) $500,000. Client, M. W. Frudakis, Arch.
¶ Foundation and underpinning for office building, Brooklyn. (struc.) Client, T. Goldstone, Arch.

NORTH CAROLINA

J. C. Harrison
Spartanburg, South Carolina
¶ Brevard High School, Brevard, N. C. (mech.) $1 million. Client, McDonald & Daniels, Arch.

NORTH DAKOTA

L. W. Burdick Engineering
Grand Forks, North Dakota
¶ Williston water plant intake. (civil) $1 million. Client, City of Williston, N. D.

K. B. MacKichan & Associates
Grand Forks, North Dakota
¶ Sewage collection system with stabilization lagoon, Berthold, N. D. (civil) $100,000. Client, City of Berthold.
¶ Street improvements, including curb, gutter, base, stabilized base, and storm drainage, Parshall, N.D. (civil) $250,000. Client, City of Parshall.

OHIO

Mayer & Valentine
Cleveland, Ohio
¶ Gas conversion and new boilers, Central Junior High & Shore Junior High, Euclid, Ohio. (mech., elec.) $300,000. Client, Euclid Board of Education.
¶ Municipal building, City of Lakewood, Ohio. (mech.) $800,000. Client, City of Lakewood.

PENNSYLVANIA

George A. Gieseke
Philadelphia, Pennsylvania
¶ Sewage treatment plant, Immaculata College, near Malvern, Pa. (civil, mech., elec.) $90,000. Client, Immaculata College.

Gustav Stueber
Pittsburgh, Pennsylvania
¶ Assumption Greek Orthodox Church and parish house, Beaver Falls, Pa. (civil, struc.) $300,000. Client, Wallover Petz & St. Jean Associates.
¶ Building for Lock Four Volunteer Fire Co., North Charleroi, Pa. (struc.) $150,000. Client, B. D. Trnavsky, Arch.

OREGON

Cornell, Howland, Hayes & Merryfield
Corvallis, Oregon
¶ Preliminary study of temperature and humidity control ventilating system, Salem, Ore. (mech., elec.) $30,000. Client, Oregon State Board of Control.

TEXAS

Forrest and Cotton
Dallas, Texas
¶ Pump station at Iron Bridge Reservoir. $1.5 million. Client, City of Dallas, Texas.
¶ Pipeline from Iron Bridge Reservoir to East Side Treatment Plant. $12 million. Client, City of Dallas, Texas.

FOREIGN

Fred S. Dubin Associates
Hartford, Connecticut
¶ Film studio, Puerto Rico. (heating, ventilating, plumbing, air conditioning, electrical) $500,000. Client, Julian von der Lancken, Arch.
¶ American Pavilion, Poznan, Poland. (elec.) Client, Reino Aarnio, Architect. ▲▲

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the most durably engineered turbine type pump yet built . . .

the NEW SCHAUB POWER PLANT Boiler Feed Pump

TWO-STAGE CENTER MOUNTED
1750 RPM
CAPACITIES to 150 GPM
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Now—Get ALL the Advantages of a Turbine Pump —WITH TWICE THE PUMP LIFE!

- Improved head range and NPSH characteristic of turbine pumps.
- Exclusive, super-hardened, triple-life impellers.
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- Less maintenance, easier servicing.

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DuraHard® Electrolized Impellers

A super-hard (1100 Brinnel) "skin" of dense, non-magnetic alloy resists wear, corrosion and erosion. Will not chip, peel or spall. When, or if it eventually wears through, the base metal in its original dimension still has normal service expectancy! Electrolizing also relieves impeller of stresses set up during forming and machining . . . Increases impeller life up to 300%.

Now, for the first time, you can specify or design a boiler feed system offering the advantages and better head characteristics of the turbine pump—*and get maximum pump life, too!*

The new Schaub Power Plant Pumps are "over-strength" in all components. Double-row, pre-lubricated ball bearings are oversize for a wider margin of safety. Newly improved Schaub Flexi-matic Seals permanently end packing problems, scored shafts, lubrication wash-out and seal leaks. Heavy-duty housing and bearing arms keep pumps "in line" and prevent warpage. Low stuffing box pressure doubles shaft seal life.

In short, we believe that in Schaub Power Plant Pumps you now have available to you the most trouble-free turbine pump ever built! Even its minimum maintenance needs have been made easier, quicker . . . and inexpensive.

Schaub Power Plant Pumps are one more good reason for specifying Schaub Boiler Feed Systems. *It will also pay you to specify them for individual pumps and replacements.*

WRITE FOR NEW BULLETIN No. 65 ● Get the full facts on this new major break-through in turbine pump design. Technical data, pump "lore", specifications, dimensions and capacity ratings. A must for consulting and power engineers.

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VALVE*

with the Sliding Gate and Plate
the heart of the OPW-JORDAN Valve
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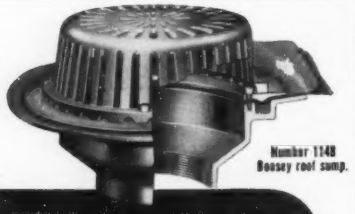

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BOOSEY
roof drains feature self-cleaning bowls

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Books

For the Libraries of Consulting Engineers

DESIGN OF STEEL STRUCTURES INCLUDING APPLICATIONS IN ALUMINUM, by E. H. Gaylord, Jr., and C. N. Gaylord; McGraw-Hill Book Co., Inc., 540 pp.; $7.50.

Reviewed
by
Karl V. Steinbrugge
Structural Engineer
Pacific Fire Rating Bureau

The two authors have covered effectively and very well the subject of modern practice in structural steel design. Tension and compression members as well as beams are treated in considerable detail. All types of structural connections are reviewed and emphasis has been given to the effects of eccentricity.

The applications of the basic design principles are included in the chapters on "Industrial Buildings," "Steel Bridges," and "Multistory Buildings." No detailed discussion of rigid frame knees is to be found. However, a chapter on plastic design is included.

The practicing engineer, wishing to refresh his memory on the design or stress analysis of unusual framing members, generally will find a suitable example in his text. For example, twist buckling failure of angle columns is discussed although the provisions for this type of failure are not covered in any of the design specifications.

Aluminum as a structural material has been allotted space in several chapters, but the authors' treatment falls short of that given to steel. The practicing engineer can, however, obtain considerable background into the reasons for some of the design differences between the two materials.

Tables are at a minimum and the authors are to be commended for not padding the book with information available in the AISC manual or like books in common use.

The background and reasoning behind code provisions is discussed frequently. This analysis by the authors leads to what every practicing engineer knows: a "practical" code can be arbitrary in some cases and also not necessarily safe for every possible design situations.

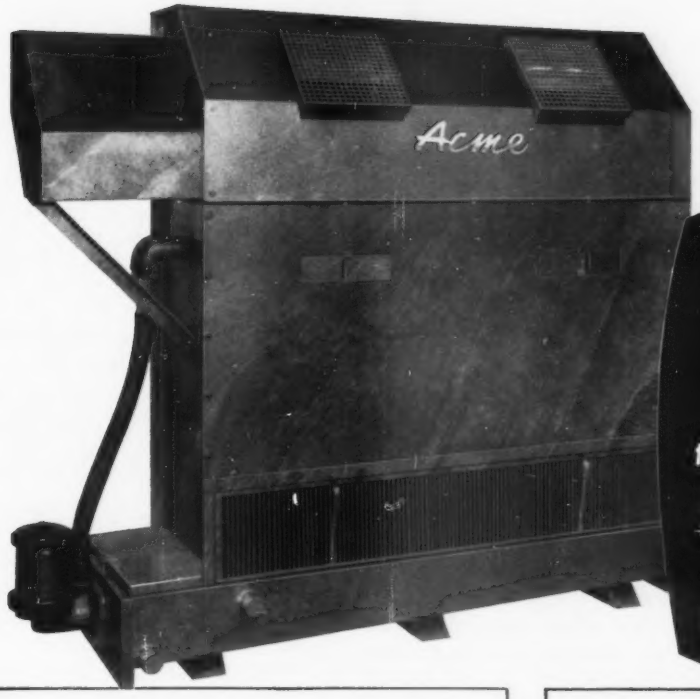
The consulting engineer who wishes to review his structural steel design methods will find the book quite adequate for this purpose. Newer topics have footnotes giving sources of supporting research.

•

CONCISE GUIDE TO PLASTICS, by R. Simonds; Reinhold Publishing Corp., N.Y.; 318 pp.; $6.95.

Reviewed
by
Allen L. Alexander
Head, Organic and Biological Chemistry Branch
U. S. Naval Research Laboratory

The author, a consulting engineer specializing in plastics and their applications, has brought together an imposing array of data and gen-



6 GOOD REASONS WHY you should specify the NEW Acme FLOW-MIZER® COOLING TOWERS and EVAPORATIVE CONDENSERS

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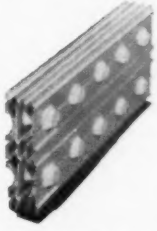
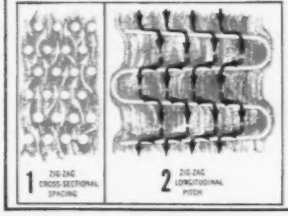


The new all-plastic Acme-Pak makes Acme towers lighter, more economical than ever. In an average unit (100-ton), the entire pack now weighs only 180 lbs as against 2300 lbs for a comparable steel pack! This means real savings on installations and on freight. Better still, it can never rot nor rust . . . . is cleaned more quickly, less frequently. Total savings are two-fold: lower installed cost, lower maintenance cost.

2 Zig-Zag coil spacing means greater capacity, less HP in NEW FLOW-MIZER evaps



Acme's zig-zag spacing improves coil efficiency in two ways. (1) By staggering the tubes, air and spray water travel a longer zig-zag path, effecting greater turbulence and better heat transfer. (2) By sloping the tubes longitudinally, spray water remains in longer contact with each tube. Also, the condensed refrigerant drains more rapidly. The result is more efficient evaporation . . . which means more capacity in less space with less blower hp.

3 Twice as much surface protection

Acme's hot-dip galvanizing *after* fabrication deposits twice the thickness of zinc that ordinary electroplating does. This double protection against rust leaves no surface exposed. Units never need painting.

4 Easily serviced external sump

On both cooling towers and evaps, Acme's external sump provides quick easy access. Sediment screen, float valve, and water treatment facilities are reached by lifting the cover.

5 Full access to coil or pak

For fast, easy maintenance, the new Acme units offer convenient access to nozzles, eliminators, pack or coil by removal of full-width panels front and rear. Sliding doors provided for quick inspection.

6 Balance where it counts

After final assembly, All Acme blower units are now electronically balanced to assure quiet, smooth operation at all times . . . less wear on blower bearings . . . greater efficiency . . . longer trouble-free service.

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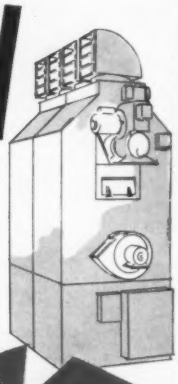

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eral information describing the origin, properties, uses, methods of fabrication and processing, sources of supply, and costs of all the important commercial plastics presently available in the United States. Newcomers, about to embark into any field involving plastics, will find the "Concise Guide" a highly illuminating introduction. Others, who may have become over-specialized in some particular area of the plastics field, will find this book both refreshing and helpful in regaining a balanced perspective. It should be useful for orientation purposes generally.

The introductory chapter contains a brief history of the development of the plastics industry. A chronology is included listing the dates on which most plastics of current importance were introduced beginning with celluloid in 1870 and continuing through urethane (molding powder) in 1955.

While approximately 50 major plastic types exist, the author considers 32 sufficiently important to include in a detailed discussion of properties in the fullest and perhaps most informative chapter of the book. Physical and engineering data are presented for each type. Chemical, mechanical, structural, and electrical data are presented in tabular form. Processibility, along with current and suggested uses are discussed. Several tables of comparative properties of competitive resins add further to the interest in the descriptions of properties. A short chapter is devoted to the several forms in which plastics exist with suggestions as to types most readily adapted to adhesives, coatings, fibers, moldings, laminates, and extrusions. A subsequent section deals with costs and production figures.

Consulting engineers should find the chapters on applications, processes, and plastic selection exceedingly helpful as sufficient data are contained therein to warrant final recommendations for many applications without additional references. The book concludes with a complete listing of all domestically produced plastics by trade name, each of which is identified by its chemical name and/or physical forms in which available. The producer or source of supply is included in each case.

•

AREA MANPOWER GUIDEBOOK, a new publication of the U. S. Department of Labor, is now available. This 380-page book, covering 174 of the nation's most important industrial centers, is a basic reference source for use in plant location studies, economic and market research, and manpower recruitment. Such data as area population statistics, industrial characteristics, and review of significant labor market trends also are included. The book may be ordered from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D.C., for $1.75.

•

COUNTERFLOW COOLING TOWER PERFORMANCE; J. F. Pritchard Co. of California; 85 pp.; $3.00.

This comprehensive manual is an up-to-date compilation of information on the subject of counterflow cooling tower selection and performance. Under a single cover are found the data necessary for the sound engineering estimate of cooling tower size, fan capacity, and pumping head.

In addition, the data can be used to determine cooling tower performance at other than design conditions, as well as predict performance of a specified tower at a single design condition.

The text is carefully arranged and can serve as an introductory text on the subject to the engineer unfamiliar with counterflow cooling tower design.

This manual may be ordered by writing to: Literature Dept., J. F. Pritchard & Co. of California, 4625 Roanoke Parkway, Kansas City 12, Missouri. ▲▲

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quality standard for steel roof deck!

■ Since its origination in the early '20s as the first insulated roof deck, Holorib has been recognized as the quality design standard for this type of construction. Its exclusive features give you many important advantages.

The pyramidal-shaped ribs which distinguish Holorib provide greater lateral and vertical stability than ordinary designs. This greater strength allows heavier loads on longer purlin spacings. The narrow rib openings—⅜"—give full bonding area and a firm support for insulation as well as allowing a minimum waste of bonding materials. The broad base—1"—rests firmly on the purlins for a balanced structural section and greater welding area.

Holorib design features also speed up construction and provide tight joints to eliminate asphalt leakage. The telescoping end laps provide for expansion and contraction and give positive connection. The side laps interlock with the complete last rib of the adjoining sheet to assure full and equal strength at all points. No side lap fasteners are required. The positive side lap, telescoping end laps and full flange support for the roofing materials above insure proper performance of the entire roof assembly.

Fenestra* Holorib Steel Roof Deck is rolled in lengths that permit economical spacing of purlins and the design advantage of continuity over supports. Full 18" coverage gives fast erection.

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Non-piercing insulation clip now available exclusively for Holorib. This provides fast construction and a positive anchor for insulation when the asphaltic vapor barrier or adhesive is eliminated between deck and insulation.

Be sure to get the quality design and construction advantages of Fenestra Holorib Roof Deck. Specify it exactly . . . there is no equal. Check any alternates for bonding area, strength and stability of section at all ribs, end and side lap details, insulation fastening, and speed of installation. There is no comparison to Fenestra Holorib. For complete details, get your FREE copy of the *1958 Fenestra Building Panel Catalog*. Call your local Fenestra representative—listed in the Yellow Pages—or write, Fenestra Inc., Dept. CE-6, 3443 Griffin Street, Detroit 11, Michigan.

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Fenestra Holorib Roof Deck is also available as Acoustical Holorib and as Holorib Reinforcing Forms for concrete construction.

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Consulting Engineers' Calendar

Date	Sponsor	Event	Location
June 3	New York Association of Consulting Engineers	Seminar on Composite Steel and Concrete Construction Design	Hotel Roosevelt New York, N. Y.
June 5-6	University of Wisconsin	Institute for Consulting Engineers	Campus Madison, Wis.
June 5-7	Michigan Society of Professional Engineers	Annual Convention	Pantlind Hotel Grand Rapids, Mich.
June 8-13	Society of Automotive Engineers	Summer Meeting	Chalfonte-Haddon Hall Atlantic City, N. J.
June 12-14	National Society of Professional Engineers	General Meeting	Chase Hotel St. Louis, Mo.
June 15-19	American Society of Mechanical Engineers	Semiannual Meeting	Hotel Statler Detroit, Mich.
June 22-25	American Institute of Chemical Engineers	50th Anniversary Meeting	Bellevue-Stratford Hotel Philadelphia, Pa.
June 22-27	American Institute of Electrical Engineers	Summer General Meeting	Hotel Statler Buffalo, N. Y.
June 22-27	American Society for Testing Materials	Annual Meeting and Exhibit	Hotels Statler, Sheraton-Plaza Boston, Mass.
June 23-25	American Society of Heating and Air-Conditioning Engineers, Inc., and American Society of Refrigerating Engineers	Joint Meeting	Pick-Nicollet Hotel Minneapolis, Minn.
June 23-27	American Society of Civil Engineers	National Convention	Multnomah Hotel Portland, Ore.
Aug. 11-14	Society of Automotive Engineers	National Meeting	The Ambassador Los Angeles, Calif.
Aug. 17-22	Illuminating Engineering Society	National Technical Conference	Royal York Hotel Toronto, Canada
Aug. 19-22	American Institute of Electrical Engineers	Pacific General Meeting	Hotel Senator Sacramento, Calif.
Sept. 15-20	Engineers Joint Council	International Congress on Large Dams	The Statler Hilton New York, N.Y.
Sept. 15-19	Instrument Society of America	Instrument-Automation Conference	Convention Hall Philadelphia, Pa.

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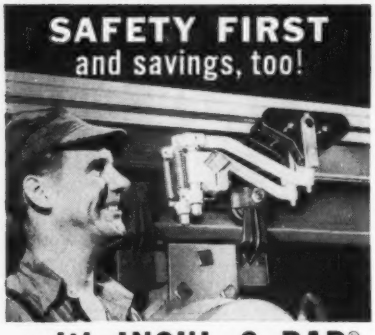
ADVERTISERS' INDEX

Acme Industries, Inc. 195
Adams Co. Inc., R.P. 171
Advance Transformer Co. 21
Aerovent Fan Co. Inc. 10
Allen Mfg. Co., W.D. 14-15
American Blower
Div. of American-Standard 139
American-Marsh Pumps 170
Ames Iron Works, Inc. 43
Ammerman Co. Inc. 188
Anaconda Wire & Cable Co. 153
Anemostat Corp. of America 13
Arrow-Hart & Hegeman Electric
Co., The 17
Asphalt Institute, The 22-23
Babcock & Wilcox Co., The 175
Baldwin-Hill Co. 191
Baltimore & Ohio Railroad 117
Barber-Colman Co. 181
Barnstead Still & Demineralizer Co. 192
Bayley Blower Co. 57
Bayley Co., The William 137
Bituminous Coal Institute 26-27
Boiler Engineering & Supply Co. Inc. 123
Boosey Mfg. Co., Norman 194
Borden Metal Products Co. 29
Bowser, Inc. 126
Bruner Corp. 73
Buell Engineering Co. Inc. 187
Buffalo Forge Co. 202
Burt Mfg. Co., The 146
Byers Co., A.M. 183
Cambridge Filter Corp. 128
Canton Stoker Corp.
Wagener Pump Div. 50
Carrier Corp. 53
Caterpillar Tractor Co. 30-31
Chicago Blower Corp. 133
Climax Engine Mfg. Co. 163
Clyde Iron Works, Inc. 37
Combustion Engineering 11
Condenser Service & Engineering Co. Inc. 44
Connor Engineering Corp. 75
Continental Wire Corp. 58
Curtis Mfg. Co. 161
Day-Brite Lighting, Inc. 140-141
Dean Products Inc.
Dean Thermo-Panel Coil Div. 192
Dearborn Chemical Co. 200
DeBothezat Fans 166
DeLaval Steam Turbine Co. 4
Detroit Stoker Co. 131
Diamond Power Specialty Corp. 51
Dunham-Bush, Inc. 47
Edwards Co., Inc. 143
Electric Storage Battery Co., The 74
Everlasting Valve Co. 138
Executone 52
Fenestra Inc. 197
Foster Engineering Co. 172
General Cable Corp. 25
General Chemical Div.
Allied Chemical Corp. 35
General Electric Co. 38-39
Globe Co., The 70
Golden-Anderson Valve Specialty Co. 42
Hagan Corp. 61
Hardinge Co., Inc. 72
Hartzell Propeller Fan Co. 3
Haws Drinking Faucet Co. 34
Hendrick Mfg. Co. 186
Hilliard Corp., The 156
Hotel Wolverine 196
Illinois Engineering Co. 149
Illinois Water Treatment Co. 182
Industrial Combustion 144
Inland Steel Products Co. 136
Insul-8-Corp. 200
Irving Subway Grating Co. Inc. 190
I-T-E Circuit Breaker Co.
Small Air Circuit Breaker Div. 124-125
Switchgear Div. ..... Fourth Cover
Transformer & Rectifier Div. 91
Jenkins Bros. 147
Jenn-Air Products Co. Inc. 129
Johnson Co., S.T. 32
Johnson Gear & Mfg. Co. 176
Jordan Corp. 194
Keasbey & Mattison Co. 145
Kewanee Boiler
Div. of American-Standard 185
Kinnear Mfg. Co., The 130
Kirlin Co., The 201
Kraloy Plastic Pipe Co. 178
Lennox Industries Inc. 196
Leupold & Stevens Instruments, Inc. 169
Lewin-Mathes 135
Liquidometer Co. 58
Magnetrol, Inc. 113
Mahon Co., The R.C. 150-151
Marietta Concrete Corp., The 174
Master Builders Co., The ..... Third Cover
Nesbitt, Inc., John J. 165
New York Blower Co., The 107
Niagara Blower Co. 178
Northern Blower Co., The 154
Nugent & Co., Inc., Wm. W. 68
Ohio Injector Co., The ..... Second Cover
Peerless Electric Co., The 71
Peerless Pump Div.,
Food Machinery & Chemical Corp. 45
Penn Ventilator Co. 173
Pennsylvania Dept. of Commerce 180
Petro 179
Petrometer Corp. 60
Pratt Co., Henry 159
Pritchard Co. of California, J. F. 41
Propellair
Div. of Robbins & Myers, Inc. 118
Pyle-National Co., The 9
Radio Corp. of America
Sound Products Div. 116
Reliance Gauge Column Co., The 160
Reznor Mfg. Co. 48
Rockwell Co., W. S. 16
Rockwell Standard Corp.
Grating Div. 176
Ronald Press Co., The 36
Roots-Connersville Blower
A div. of Dresser Industries, Inc. 99
Roper Hydraulics, Inc. 76
Royal McBee Corp. 67
Schaub Engineering Co., Fred H. 193
Sier-Bath Gear & Pump Co., Inc. 158
Sika Chemical Corp. 184
Sorgel Electric Co. 157
Speedline Stainless Steel Fittings
Horace T. Potts Co. 189
Standard Electric Time Co. 177
Stebbins Engineering & Manufacturing
Co. 106
Stromberg-Carlson Co. 162
Sun Chemical Corp.
A. C. Horn Co. 12, 60
Superior Combustion Industries Inc. 33
Temprite Products Corp. 168
Thompson Electric Co., The 134
Todd Shipyards Corp. 180
Tubular Products Inc. 167
Union Wire Rope Corp. 18-19
U. S. Gauge, Div. of
American Machine & Metals Inc. 46
U.S. Steel Corp.
AmBridge Steel Joists 49
Structural Steels Div. 6-7
Vogt Machine Co., Henry 69
Weil-McLain Co. 155
Weinman Pump Mfg. Co., The 164
Westinghouse Electric Corp.
Standard Control Div. 62-63-64-65
Wheelock Signals, Inc. 132
Whiting Corp. 59
Wickes Boiler Co., The 54-55
Wright-Austin Co. 148
Yarnall-Waring Co. 77
York Corp. 199



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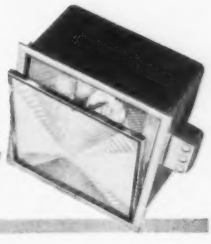

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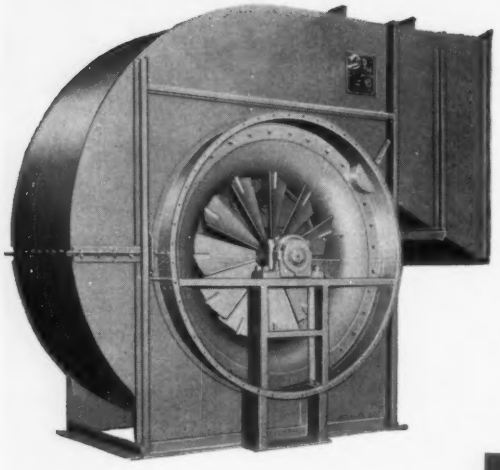

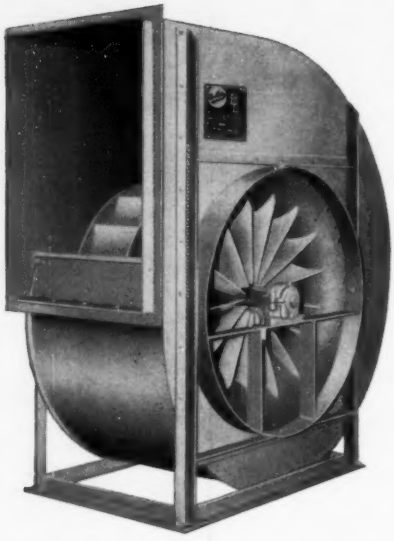

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Investigate the "BLH" for your high pressure requirements. Consult your nearest "Buffalo" Engineering Representative, or write today for Bulletin F-200.

FOR MODERATE PRESSURES: "BUFFALO" TYPE "BL" The "Buffalo" Type "BL" Fan has won a solid reputation for efficient performance in many of the largest Class I & II installations. Non-overloading like the "BLH", the "BL" is noted for quiet, stable output from free delivery to shutoff. Unusual design features of the "BL" are responsible for its high operational efficiency. For example, minimum turbulence is assured by the smoothly curved inlet bell with directional guide vanes. Other "BL" features include the rigid wheel, tested and balanced at the factory and the correctly shaped scroll of the "wheel-suited" housing.

For peak performance on your moderate pressure systems, ask your "Buffalo" Representative about the "BL" — or write us for Bulletin F-102.

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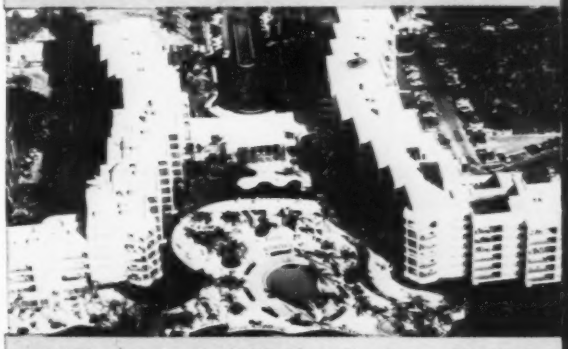

Palm Beach Towers Hotel, Palm Beach, Fla.; Arch. — John Hans Graham & Assocs., Washington, D. C.; Struc. Engr. — Oboler & Clarke, Miami; Consltg. Engr. — Norman C. Schmid & Assocs., Palm Beach; G. C. — Taylor Construction Co., Miami; POZZOLITH Ready-Mixed concrete — Burnup & Sims, and Rinker Materials, West Palm Beach.

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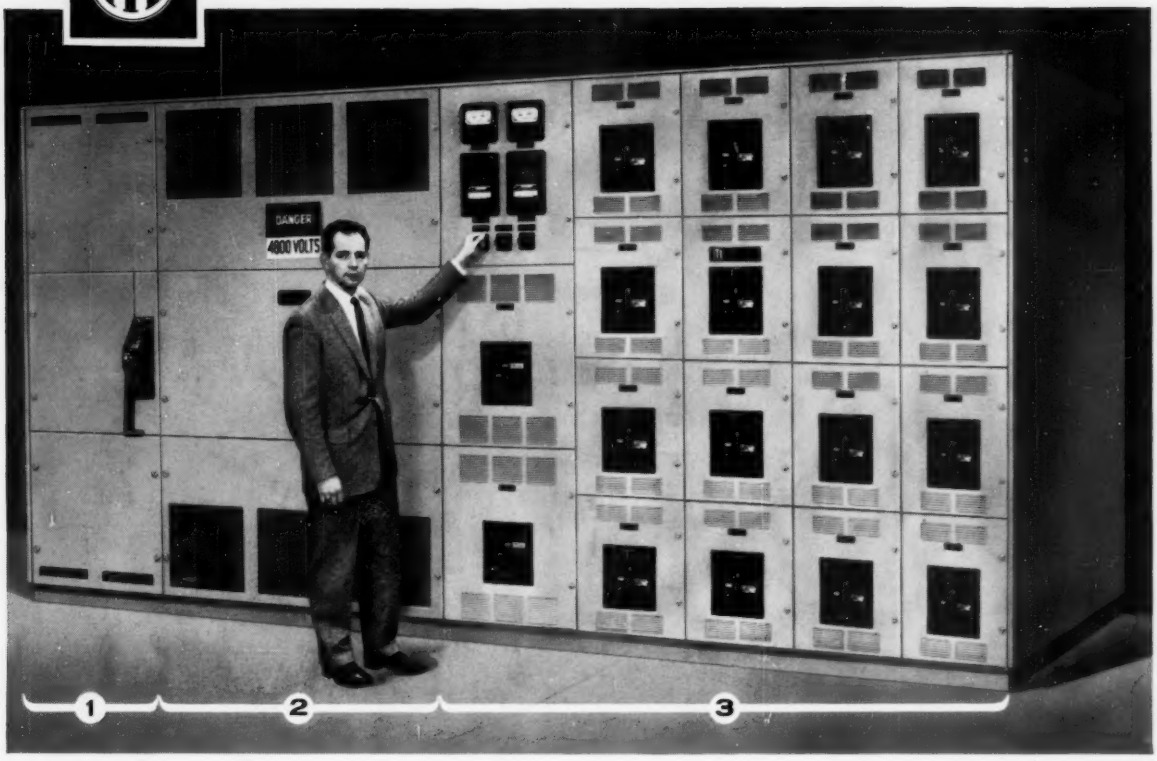

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